JOINT USE OF POLES

Purpose: This addendum provides additional information for the design of cable plant in joint-use construction.

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- 6. Data for power lines using other than no. 4 7/1 acsr wire

SAG CHARTS 1 to 6 INCLUSIVE

1. SCOPE

1.01 The information herein is for use in the design of joint-use of cable weighing 1.5 pounds per foot or more. It supplement Addendum No. 2 to REA TE & CM-690, "Joint Use of Poles" which is limited to design where the cable weighs 1.0 pound per foor less.

2. GENERAL

- 2.01 The design engineer must determine the clearances and points of attachment to power poles for cables which exceed 1.0 power foot. The solution for a specific project can be worked out graphically as explained herein. The method can be used for making rapid checks to determine whether or not the power poles will provide vertical clearances required by the NESC rules with a desired cable on them.
- 2.02 In urban areas where spans usually are 150 feet or less, it may not be necessary to use this graphic method. In such spans the power wire sags and the cable sags are considerable.

less than in the long spans usually found in rural areas. In short spans the cable sags usually will exceed the power wire sags. By the use of the clearance rules stated in the following paragraphs, the required separations for these short spans can be quickly determined.

2.03 Reference should be made to REA TE & CM-630, "Design of Aerial Cable Plant" for information as to the grade of galvanizing or other coating on the suspension strand for use in areas where corrosive atmosphere exist.

3. JOINT USE CLEARANCE AND SEPARATION RULES

- 3.01 In joint-use construction certain clearance and separation rules are stated in the National Electrical Safety Code (NESC). A cixth edition of the Code was issued by the National Bureau of Standards, dated November 1, 1961, as Handbook 81. This can be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., priced at \$1.75 per copy. In those States where the fifth edition is in effect by law, it must be continued as a guide until the sixth edition is adopted. Certain States have rules that are more stringent than the NESC rules and these must be complied with. The NESC rules of the sixth edition are referred to herein.
- 3.02 The NESC rules make distinctions as to clearances and separations depending on whether the power line voltage is below 8700 volts to ground or above this voltage. One set of rules applies where the power line supports secondary power wires and a different set where it does not.
- 3.03 The rules applicable to cable on power poles which do not support secondary power wires are as follows: (See Figure 1 in TR & CM-690 which shows certain joint-use separation requirements).
 - a. For spans exceeding 150 feet, the attachment point of the strand to power poles must be at least 40 inches (for practical purposes 3.5 feet can be assumed) below the lowest power wire attachment point, usually the power neutral wire, for power lines not exceeding 8700 volts to ground and at least 60 inches if the power voltage exceed 8,700 volts but does not exceed 15,000 volts to ground.
 - b. The minimum vertical separation required at supports between the strand and grounded ron-current carrying power system equipment, such as transformer cases, is 30 inches.
 - c. The final unloaded sag of a cable at 60° F. must comply with the ground clearance rules of the NESC which are stated in REA TE & CM-602. "Clearances."

- d. MESC Rule 238 h 3(c). "For spen lengths in excess of 150 feet, vertical separation at the pole between open supply conductors and communication cables or conductors shall be adjusted so that under conditions of 60° F, no wind and final unleaded say, so supply conductor of 750 volts or less shall be lover in the span than a straight line joining the points of support of the highest communication cable or conductor, and no supply conductor of over 750 volts but less than 50,000 volts shall be lower in the span than 30 inches above such a straight line." This means the strand line of sight attachment points must be at least 30 inches below the low point in the sag of the phase wire in Figure 1, but the multigrounded neutral wire may sag below this line of sight of the strand.
- e. The initial say of a bare strand when installed or a cable on strand must provide at least 30 inch clearance between the lowest power wire (in this case usually the neutral wire) and the strand at 60° F. with no wind for for power lines not exceeding 8700 volts to ground and 45 inch clearance if the power line exceeds 8700 volts to ground.
- 3.04 The rules applicable to cable on power lines which do support secondary wires are as follows: (See Figure 2 in REA TE & CM-690 which shows certain joint-use separation requirements.)
 - a. Same as par. 3.03a, above.
 - b. Same as par. 3.03b, above.
 - c. Same as par. 3.03c, above.
 - d. Same as par. 303d, above. However, this means in this case that the strand line of sight must be not higher than the low point of sag of the lowest secondary wire which is in the class of power wires of 750 volts or less.
 - e. The initial sag of a bare strand when installed or a cable on strand must provide at least 30 inch clearance between the lowest power wire (in this case the lowest secondary wire) and the strand at 60° F. with no wind for power lines not exceeding 8700 volts to ground and 45 inch clearance if the power line exceeds 8700 volts to ground.
- 3.05 When suspension strand is installed, it has much less sag than after a cable is placed on it. Power wires have considerable sag in long span rural construction. Consequently,

it may be necessary to attach the strand temporarily at a point below its final attachment point to prevent contact with power wires above it on the same poles until cable is placed on the strand. The temporary means of attachment can be by driving lag bolts into the poles or by placing other soltable support hardware at proper height to give temporary clearance. Washers can be placed on the bolts and the strand can be placed on the bolts between the washers and the poles. The strand then can be secured to the poles with 0.109 inch steel line wire to hold it temporarily until after the cable is supported by the strand. The strand and cable then can be raised to the throughbolts and the strand attached by three bolt clamps in the standard manner.

IN THE PREPARATION OF FIGURE 1 - POWER LINE WITHOUT SECONDARIES NO. 4 7/1 ACSR WIRES)

Figure 1 is a graphic solution for a joint-use situation in which it is assumed that the following factors apply:

- a. Ruling span 387 feet (Taformation from power company)
- b. Average span 350 feet (Information from power company)
- c. Power line voltage 8700 volts to ground (Information from power company)
- d. Power wires No. 4 7/1 ACSR (Information from power company)
- e. Cable weight per foot 1.5 lb. (Table i TE & CM-630, "Design of Aerial Cable Plant.") This table shows that 100-pair 19-gauge, 200-pair 22-gauge, and 300-pair 24-gauge plastic cables for aerial use weigh in the order of 1.5 lb. per foot.
- f. Power line poles 35-foot (Information from power company)
- g. Configuration of power wires on the poles. (See RD Figure 16 in REA TE & CM-690 which is the pole head configuration drawing.)
- h. Ground clearance desired 14 feet for the cable at final unloaded sag at 60° F.
- i. Storm loading district heavy

Other data required in the graphic solution, available in REA documents, include:

spant in the heavy loading district. The Sag Charts 1 and 1 in REA TE & CM-630 show that a lOM strand is required for 1.5 lb. cable for 350-foot spans in the heavy s'orm loading district.

strand stringing (initial) sag at 60° F. for 350-foot. This is approximately 2 feet on Sag Chart 2 herewith.

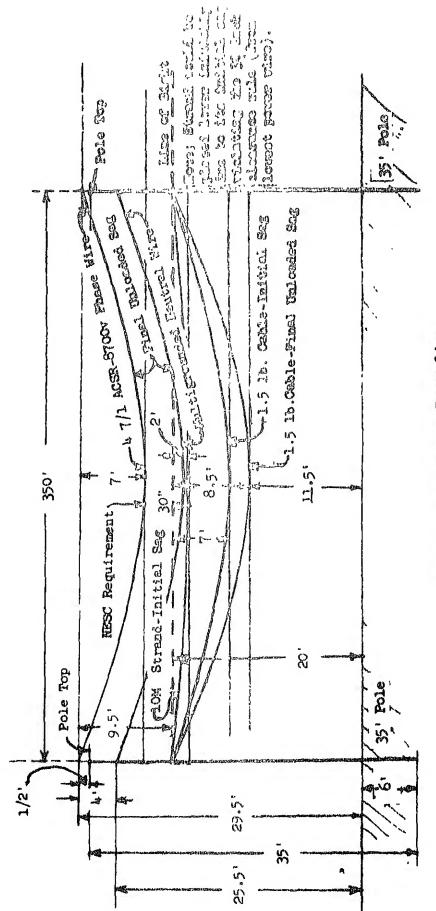
- c. The initial sag of the 1.5 lb. cable on 10M strand for 350-foot spans. This is approximately 7 feet shown on Sag Chart 5 herewith.
- d. The final unloaded sag of the 1.5 lb. cable at 60° F. on 10M strand for 350-foot spans in the heavy loading district. This is approximately 8.5 shown on Sag Chart 4 in KEA TE & CM-630.
- e. The final unloaded sag of the No. 4 7/1 ACEN power wire at 60° F. for a 350-foot span in the heavy loading district. This is approximately 7 feet as shown on Figure 8 of Addendus No. 2 to RMA III & CM-690.
- f. The attachment distance in fact above ground of the power line neutral (lowest) wire. This is shown to be 25.5 feet on RD Figure No. 16 in REA TE & CM-690.
- 4.03 Figure 1 herewith is drawn using the rules and data presented in paragraphs 3.03, 4.01, and 4.02 above. It shows that the desired 14 foot ground clearance cannot be obtained on 35-foot power poles. Sag Chart 4 of REA TE & CM-630 shows that a cable weighing 0.75 lb. per root is the heaviest that can be used in this situation on 10M strand and still comply with the required rules as it would have the 6-foot final unloaded sag. Table 1 in REA TE & CM-630 shows that 50-pair 19-gauge, 100-pair 22-gauge, and 150-pair 24-gauge plastic cables weigh in the order of 0.75 lbs. per foot.
- 4.04 Sag Chart 7 of REA TE & CM-630 shows that the 6-foot final unloaded sag of a 1.5 lb. per foot cable on a 16M strand would provide the desired 14-foot ground clearance in this situation.
- 4.05 Figure 1 shows that the strand would require temporary location when placed because it would not clear the nautral wire by 30 inches. See paragraph 3.05.
- 4.06 In joint use on 35-foot power line poles without secondaries, the maximum final unloaded sag of a cable cannot exceed eight feet if 14-foot ground clearance is required in any storm loading district for any span length. This is based on the fact that the phase wire is 29.5 feet above ground, the neutral wire is four feet below this, and the strand attachment point must be at least forty inches (3.5 feet for practical purposes) below the neutral wire which mukes it 7.5 feet below the phase wire point of attachment. This means the strand cannot be placed higher than 22 feet above ground. The 14-foot ground

clearance leaves 8 feet for cable sag. This fact can be used as a check on the graphic solution of such problems as shown in Figure 1.

- STEPS IN THE PREPARATION OF FIGURE 2 POWER LINE WITH SECONDARIES (AND 4 7/1 ACSR WIRES)
 - Figure 2 is drawn using the same assumptions as used in making Figure 1 plus the fact that the lovest sacondary wire is assumed to be 3 feet below the multigrounded neutral wire, and that an 8-foot ground clearance is parmissible instead of 14-foot which it is evident cannot be obtained here. The line of sight rule of par. 3.04 d. applies in this situation, i.e., the line of sight must be tangent to the low point of sag of the lowest secondary wire. The other data used is the same as used in Figure 1.
 - 5.02 The final point of strand attachment to the poles would be 7 feet below the lowest secondary (which is the final unloaded sag of this secondary wire). This would place the strand 15.5 feet above ground, which is 14 feet below the top phase wire. The final unloaded sag of the cable which is 8.5 feet will make the ground clearance 7 feet where 8 feet is desired. A cable having a final unloaded sag of 7 feet would be the heaviest permissible for the span lengths assumed. Sag Chart 4 of NEA TE & CM-630 shows that a cable weighing 1.0 lb. per foot which has approximately 7 foot final unloaded sag at 350 feet would be the maximum size permissible on 10M strand in the heavy storm loading district. Table 1 in REA TE & CM-630 shows that 75-pair 19-gauge, 150-pair 22-gauge, and 200-pair 24-gauge plastic cables weigh in the order of 1.0 lb. per foot.
 - 5.03 To obtain 8 Poot ground clearance, the 1.5 lb. cable must not exceed 7.5-foot final unloaded say (90 inches) or less. Use of 16M strand would be necessary. Say Chart 7 of REA TE & CM-630 shows that with the 16M strand the final unloaded say of 1.5 lb. cable is approximately 6 feet which would result in 9.5 foot ground clearance.
 - 5.04 Figure 2 shows that the strand would require temporary location when placed because it would not clear the lowest secondary wire by 30 inches. See paragraph 3.05.
 - 5.05 In joint use on 35-foot power line poles with secondaries, the sum of the final unloaded sag of any kind of power wires plus the final unloaded sag of the cable cannot exceed 8.5 feet if l4-foot ground clearance is desired in any storm loading district for any span length. The top phase wire is attached 29.5 feet above ground. The lowest secondary is attached 7 feet below it or 22.5 feet above ground. The cable must be attached tangent

to the low point of secondary sag (assuming level ground). The ground clearance uses 14 feet of this 22.5 feet leaving 8.5 feet as the greatest possible sum of the secondary final unloaded sag and cable unloaded sag.

- 6. DATA FOR POWER LINES USING OTHER THAN 4 7/1 WIRE
 - 6.01 Final unloaded sag data for No. 6A and No. 6A copperweld and No. 6 ED copper power line wire are given on Eag curves in Addendum 2 to HEA IN & CM-690.

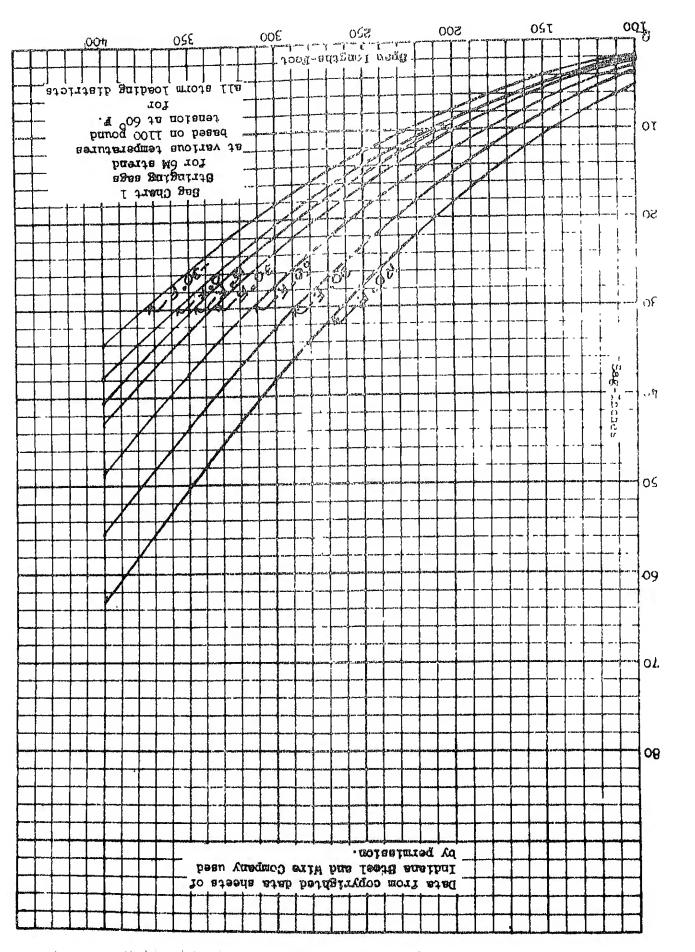


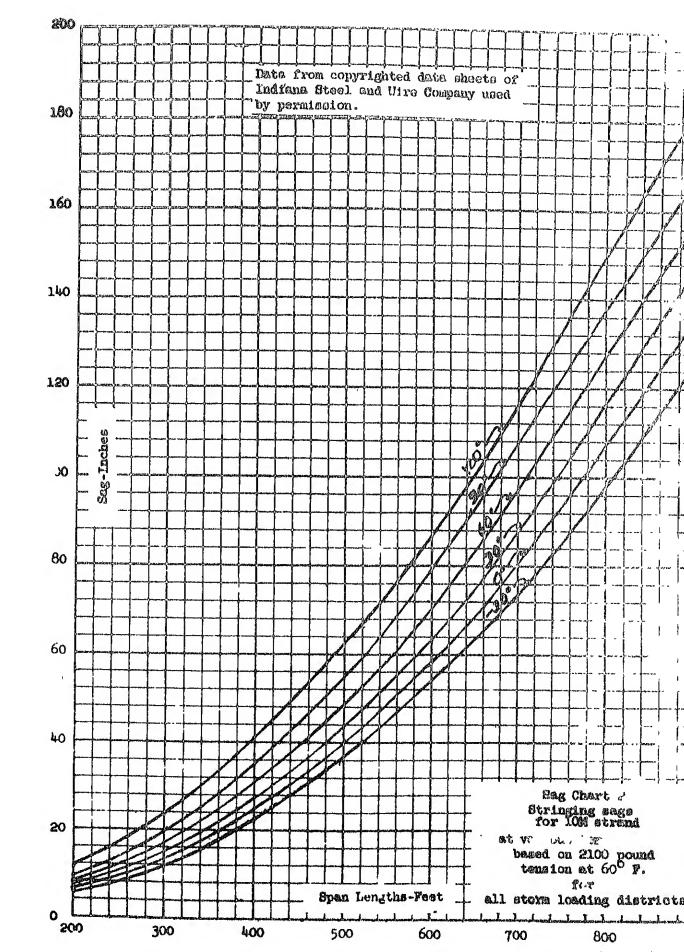
Cable in Joint Use on Power Line with no Secondaries

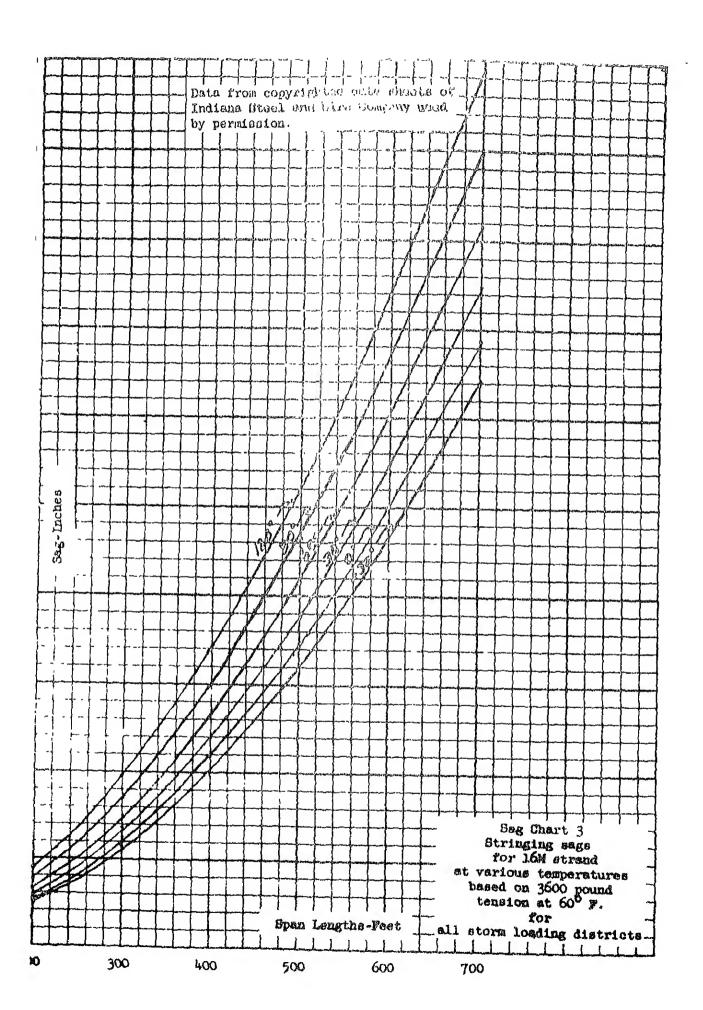
FIGURE 1

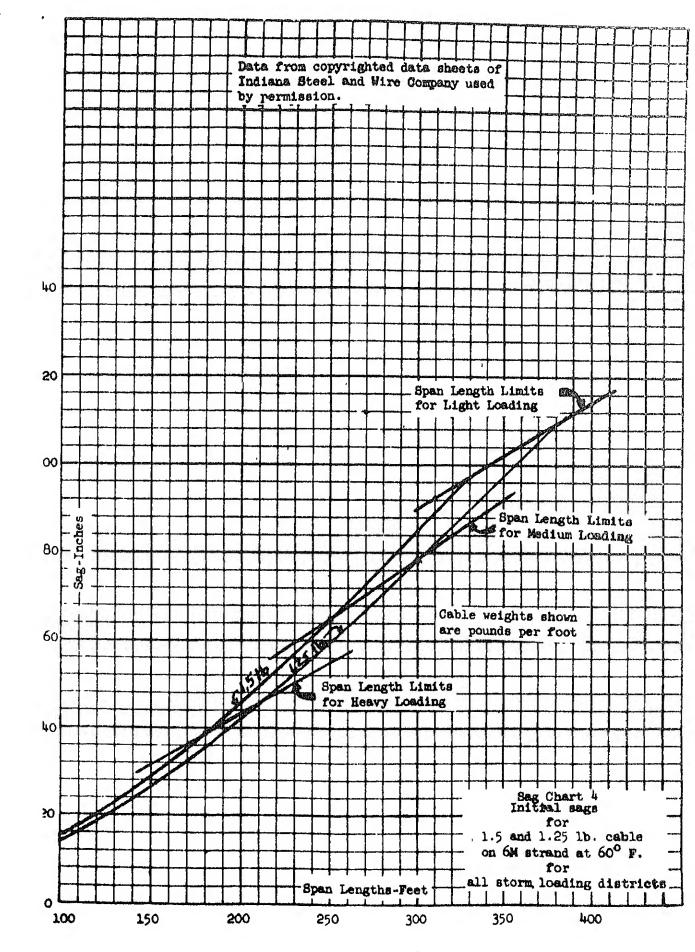
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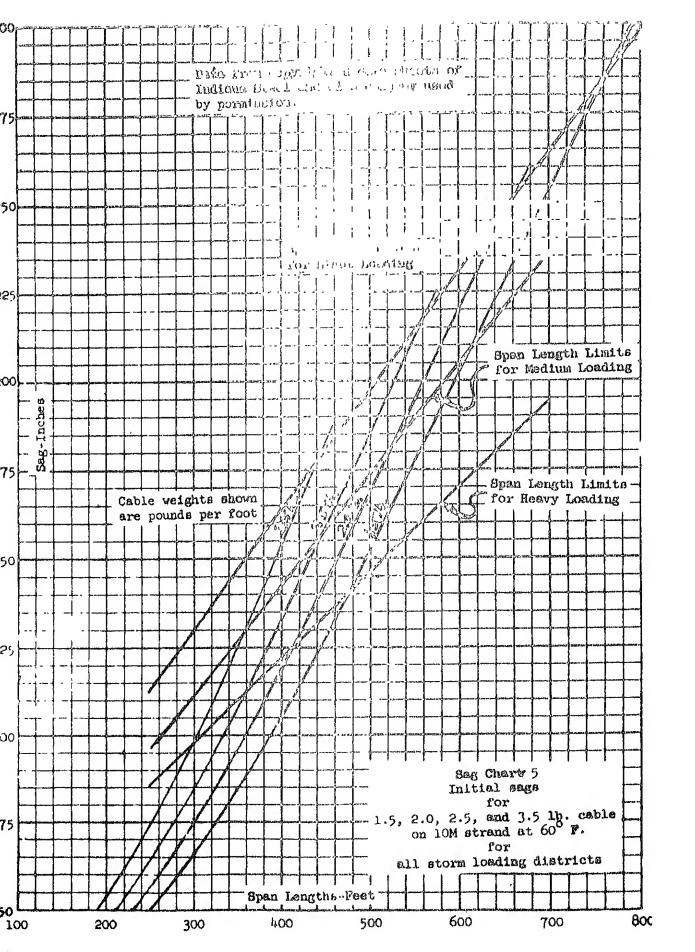
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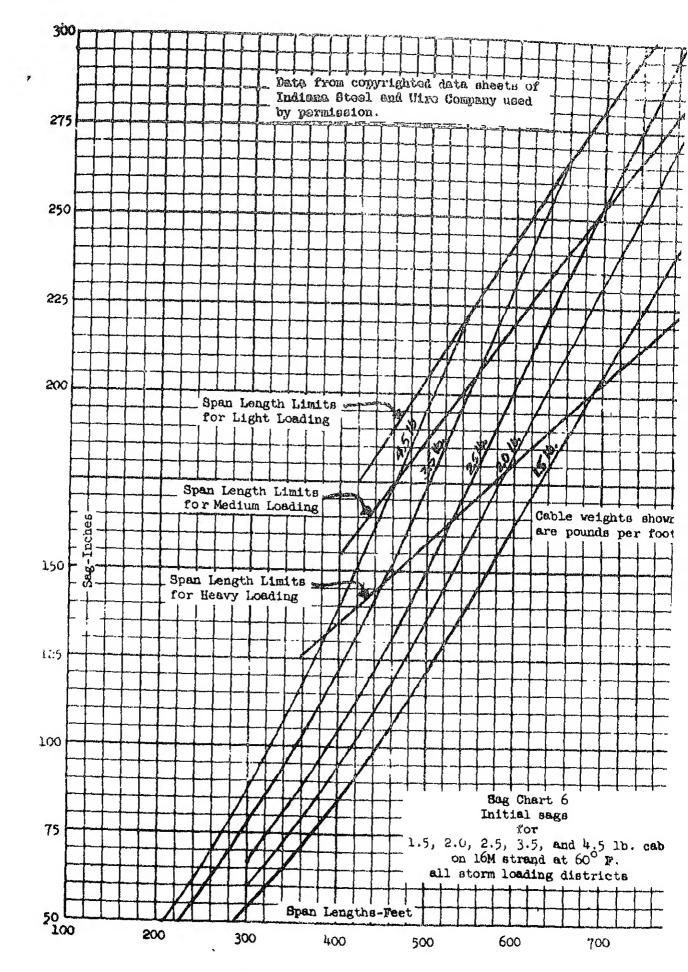












JOINT USE OF POLES

Purpose: The purpose of this addedown is to include joint use by telephone borrowers of poles carrying 14.4/24.9 kv sultigrounded neutral type of power distribution circuits. This addendum supplements Section 690 by expanding its scope.

Additions:

1. Boops

- 1.1 This eddendum discusses considerations involved in joint use of poles for mural power and telephone circuits under conditions where:
 - 1.11 Telephone circuits are open wire.
 - 1.12 Electric power circuits are of the multigrounded neutral type whose voltage from phase to ground exceeds 8700 volts but does not exceed 15,000 volts.

2. General

- 2.1 Joint use by telephone borrowers of poles carrying 14.4/24.9 kv multigrounded neutral type of power distribution "recuite is recommended, if all requirements for such joint use as set forth below can be met and if, after careful consideration of all factors involved, joint use appears to be economically and technically desirable, or if it is the best engineering solution to difficult right-of-way or construction problems.
- 2.2 Section 690 of the TE & CM discusses the considerations involved in joint use of poles for rural power and telephone circuits involving open wire telephone circuits and multigrounded neutral power circuits whose voltage to ground does not exceed 8700 volts. It is the purpose of this addendum to set forth the considerations involved in joint use of poles involving open wire telephone circuits and multigrounded neutral power circuits whose voltage to ground exceeds 8700 volts, but does not exceed 15,000 volts. Joint use with a multigrounded neutral power system is assumed throughout the discussion that follows
- 2.3 The omission of cable construction from Issue No. 1 of Section 690 was to expedite issuance of the section and in no way implies that such joint use id not desirable. Joint use of poles for electric power circuits and telephone cables will be covered in a later addendum to this section.

- 2.4 The requirements of these educate the the council and the decorate unital and the decorate unital and the matter that the explicate the production of the Matter Poly.

 Practices for Supply and Go annual to discussive an use the requirements decorated a relieved for leady voltage in Paragraphs 2.2 and 2.7 of Section 650, lower voltage joint use.
- 2.5 Strongth, ground ologramma and a debling come econolists manta for 14.4 kv joint voo alle ha sha are a no manta required by Soution 690 Res I was realisted folial man.
-). Separation Requirements Between Blanca Blanca Blanca Colegators Channelso
 - 3.1 For voltages between phase wire and naveral of 15 kg op loss, the multigrounded newspat in absorblied no bedame a 0-750 volt conductor. The the there will will be Lines of 14.4/24.9 for excious, the estation concentions between neutral or lowest recondary acadactors and telephone conductors within come out in the pare are the acres for single phase M. A ber no tro trugte phase 7.2 kvs namely, 40 inches at the pulc and ,0 inches within open. Therefore the "Vertical Separation Tublon" mound necessary in Section 690 can be used for whale phase 14.4 by John's use. In Montana, South Dakota and Arizona, state lawo have been passed which classify the usutral as boing frui 0-750 volts regardless of the tambor of phases. This posmits the separation tables of flection 690 to be used ca "V" phase and 3-phase lines having a potential of 24.9 liv between phases, in those three states. In other states, At the present time basic separations from the unitigrounded neutral or lowest secondary wire of 60 inches at the pale and 45 inches within-span mot he maintained on "V" and 3-phase 14.4/24.9 by 11mg.

5. Electrical Protection Requirements

- 4.1 Electrical protection in this instance as in the case of joint use with power circuits not exceeding 6700 volts to ground, is based on coordinated electrical protection schemes on the power and telephone systems. The definition of "coordinated electrical protestion" is given in Paragraph 6.1, Section 690.
- 4.2 The basic telephone protection devices for 14.4 ky joint use. The use are the same as are now used in 7.2 ky joint use. The short circuit currents, recloser, characteristics, and fusing of each 14.4 ky distribution line which is being considered for joint use must be checked against the time-current characteristics of the power contact protectors which would be used on the telephone circuits. This is necessary in order to determine if they are capable of handling the probable assent of energy to which they sight be subjected in the event of a contact between a power phase conductor and a telephone conductor. The time-current characteristic of a typical power contact protector is shown in Figure 2 of Section \$20, Issue No. 2.

4.3 The short circuit current of a 14.4 by live as correct with an avi lengo retued coefectodus ya foilague cail vi 8.7 talavinco retings is roughly half that of the 7.8 by line of, or near the substation. A cross-over point is usually received some distance out on the line, beyond which the short circuit current of the 14.4 ky line would be greater than that of the 7.2 ky line, but loss than the value at the substation. On the substation side of the cross-over point, there is usually an edequate difference botwoon the maximum normal load currents and foult current to make it easy to obtain reliable and positive emerction of reclosers on fault currents, without false operation on unusually high nonfault load currents. The duty on the power contact protectors on the substation side of the cross-over point would be less at 14.4 ky than on the equivalent 7.2 ky line. Therefore it is possible to handle somewhat higher kva ratings with 14.4 kv systems without exceeding the safe current-carrying capacity of the power contact protectors. Beyond the cross-over point, the higher short curcuit currents of the 14.4 kv system insure more positive operation of reclosers than is possible in an equivalent 7.2 kv system and there is little danger of burning out the power contact protectors. Although in some instances, as indicated above, the duty on the power contact protectors would be less in a 14.4 kv system than in a 7.2 kv system of the same kva rating, it is recommended that they be installed at intervals of 20 ohms of telephone conductor (one . wire) as now specified in Section 820 of the TE & CM.

5. Electric Induction at Fundamental Frequency

- 5.1 For the same average cross section configuration of wires, the open circuit electrically induced voltage in telephone circuits on a joint use power line would be almost twice as high in a 14.4 kv system as in a 7.2 kv system. Therefore approximately twice as many drains would be required on telephone circuits on a 14.4 kv line in order to reduce the induced voltage to the same level as that from the 7.2 kv line. While it is desirable to hold the induced voltage on all lines to the practicable minimum, there is no hard and fast limiting value of voltage that would be considered tolerable. Ringing, personnel, and economic considerations are also involved. Drainage units should therefore be installed in accordance with the requirements of Section 820.
- 6. Magnetic Induction at Fundamental Frequency Short-Circuit Conditions
 - 6.1 The current in a power fault to neutral or to ground not involving the telephone wires would still impress voltage

on the telephone wirse by a grante induction. The agest tudes of these length inerty-induced voltages may fixed be compared for the 16-4 to and the 7.2 kg comes on the assumption that the short-circuit currents are the second and ground. If the neutral is at the second vertical specing from the telephone conductors at 14.4 and at 7.2 kg so will normally be the case, the induced voltage will be the same in either case.

6.2 If any fault location much that the fault current in smaller at 14.4 kv, the artuation would thus favor the 14.4 kv system as against the 7.2 kv system. For femite at great distances from the substation (for which the induced voltage may still be relatively large in spite of the lowered magnitude of the fault current), the induced voltage will be higher at 14.4 kv. Local confidences will be the determining factor here. But, as a general statement, it is unlikely that abnormal magnetic induction would significently influence the choice between joint use at 7.2 and at 14.4 kv.

7. Noise

7.1 There are many factors that affect noise in circuits on a joint use line. Some of these factors are dependent on voltage, others are dependent on current. Therefore, for the same system kva rating, an increase in noise from nome sources would be expected with a 14.4 kv system as compared with an equivalent 7.2 kv system, while a decrease would be expected from other sources. The net effect of an increase in voltage would be entirely different in different situations. Therefore there is no reason to suppose that noise conditions would be materially worse in joint use at 14.4 than at 7.2 kv.

Section 690 Issue 1, Addendum 2 June 1959

JOINT USE OF POLES

Purpose: The purpose of this addendum is to supplement REA TE & CM-690, "Joint Use of Poles" and Addendum 1 thereto with information required in the design of serial cable plant in joint use construction.

Additions:

1. SCOPE

1.1 This addendum discusses joint use of poles for power circuits and serial cable in rural areas. It is intended to be used in conjunction with the REA TE & CM-690 to which it is directly related.

2. GENERAL

- 2.4 In addition to construction economies the long spans commonly used for rural power circuits reduce cable maintenance costs because less bowing occurs than in short spans and less sheath trouble results as most of this trouble occurs near poles.
- 2.5 REA has established a maximum of 60 percent of the rated breaking strength of suspension strand as the limit to which the strand shall be stressed when the strand and cable it supports are loaded with ice and wind in accordance with the National Electrical Safety Code (NESC) storm loading assumptions. These loadings are stated in REA TE & CM-611, "Design of Pole Lines."

Table 1 gives the maximum allowable average spans for plastic sheath, plastic insulated cables of various weights per foot lashed to strand, in the NESC loading areas based on the 60 percent of rated breaking strength of the strand.

TABLE 1

APPROXIMATE MAKINEM AVERAGE SPACE FOR AMERIAL
CABLE AND RELATED LOADED STRAND SHEEKOJ

		Hoavy			bedien Loading		light karding	
ity Grade	Cable	Max.	रिकाल अपन	llax.	bowsou	DOM.		
1 Strand	bo 1 ght	Spans	Tonoico	Opano	uolaaci'	Deno	Monaton	
3120	Lbe/Ft.	Foot	Mile.	Peut.	XAO.	lyout"	Lan.	
6ы	.25	325	3357	400	2945	400	5/2	
6м	.5	300	3545	1100	330 L	400	205)	
6 M	-75	250	31,113	350	3309	400	3149	
6 M	1.0	250	3698	300	3365	400	3457	
101	.25	700	5953	900	5370	200	4529	
104	.5	600	6146	700	5427	700	የ ጌ13	
1CM	.75	600	6551	700	5876	es to to	CF WI do 24	
10%	1.0	600	6931	700	6306	700	5617	

The use of 6M strand is not recommended for joint use in the light loading area where spans are in the order of 450 to 700 feet. While is because the effect of concentrated load at mid-span (splicer and tools), the relatively low strength of this size strand and the large sags required.

- 2.6 The final sag or cable will be greater than its initial stringing sag due to stretching of the strand due to wind and ice. The differences are ignored in urban or other short span construction but cannot be ignored in long spans because sags may vary as much as two or more feet between initial and final conditions even with cable weighing less than 1 lb. per foot. It is not practicable to restore cable to its original dag by pulling slack after as ice storm as is done with open wire. Consequently, it is necessary to allow initially for sag increase due to storms when determining the ground clearence and when making joint pole strand attackment points so the initial sag will give the NESC required separations from the power wires in the spans and at the poles.
- 2.7 The veights of plastic cable used by MMA borrowers in aerial plant along rural roads where power line spans are relatively long will selden exceed 1.0 lb. per foot. The data herein are limited to that required for cables not much in excess of 1.0 lb. per foot. There are many more different cable diameters and weights per foot than there are of commonly used telephone line wires. This makes it impracticable to furnish exact data for all of the cable sizes commonly used in long span construction. It is practicable to group cable sizes of approximately the same weight per foot for the purposes of this addendum, and thereby limit the number of data sheets and curves required. The data in this addendum are limited to copper conductor cables lashed to either 6M or 10M utility grade galvanized steel strand.

- 2.8 RMA power line cometruction in rural areas uses sage and tensions based on "ruling spans." Expressed os a formula it is: Ruling Span - Average Span + 2/3 (Mrs. Span - Average Span). As a general rule, MA borrowers' rural power lines make use of one of four different power conductors. Final unloaded sag curves of these four kinds of conductors are given in Figures 8 to 16 inclusive. Final unloaded mag means the mag after the conductors have been loaded with wind and ice to the amounts specified by the NESC and the load is removed. It is necessary that the kind of power conductors and the ruling span used in the joint line be known in designing joint use for telephone cable and that the theoretical final unloaded sag of the power conductors be used when determining clearances between power and communication conductors. In aerial telephone cable construction the sag and tension data are not furnished on the basis of ruling spans but on actual span lengths on the assumption that the cable is desdended at both ends of the span; in other words it is assumed that the poles do not lean due to the loading.
- 2.9 Cable suspension strand is placed to definite tensions depending on strand size and temperature. The tension is practically uniform from deadend to deadend in the strand when placed, regardless of span length variations. After a cable has been placed and supported by a strand, the sags will vary in spans of different lengths.
- 2.10 In checking the sag that results in a cable span after a job is finished, some variation for each different span length from the sag curve amount can be expected. The amount of the variation cannot be exactly forecast. The sag in a short span probably will be less than shown on the sag curve for a certain average span and greater for a span longer than the average. The sag would agree with the sag curve calculated value only in the case of a level section of line having exactly equal span lengths throughout.
- 2.11 Cable dancing, also called galloping, may occur where high winds prevail. Where there is the possibility of this phenomenon occurring, the cables should be spiraled around the strand immediately after placing, in accordance with instructions provided in REA TE & CM-635, "Construction of Aerial Cable Plant." If this is not done there is the possibility of the cable dancing sufficiently to cause contact between it and the power conductor above it.
- 2.12 REA TE & CM-635 should be consulted for construction practices.
- 2.13 All applicable requirements of the NESC should be complied with.

3. STREETH REQUIREMENTS

3.4 Longer spans could be provided by using 16M strand than with 6M or 10M but this large strand is out of proportion in size to small

cables and costs considerably more than 10M strand (about 30-35%). It is necessary to use 10M strand for small cables in extra long span construction where 6M strand would be adequate for short spans. This is because of the considerable sag that results in very long spans even with small cables if supported by small size strand.

3.5 Strand and the cable it supports can be equated in terms of bare wire for pole strength determination when using Figures RD-1 to 15 of Issue I, REA TE & CM-690, "Joint Use of Poles." The transverse load that will be added on power poles by cable lashed to strand is given in the following table of equivalents to .109 inch diameter wire.

APPROXIMATE EQUIVALENT IN NUMBERS OF 0.109 INCH DIAMETER
BARE WIRES FOR CABLE LASHED TO 6M OR 10M STRAND
FOR USE IN COMPUTING TRANSVERSE LOADS ON POLES

		Numbers of Wir	es
		ors Loading Di	
Diameter, Cable Only	Heavy	Medium	light
0.5 inch	2	2	8
0.75	2	4	12
1.0	2	4	14
1.25	l _b	ly.	16
1.5	4	14	18
1.75	1,	6	20
2.0	li	6	22
2.25	Li.	6	24
2.5	li.	6	28

Note: Diameters stated are for cable only; that is, strand diameter is not included. However, the data given in numbers of bare wires is based on the cable diameter plus the strand diameter. For example, a cable 0.5 inch in diameter lashed to a 6M or 10M strand when storm loaded equates approximately to 2 bare 0.109 inch diameter wires when these are storm loaded, in the heavy storm loading district.

CLEARANCE AND SEPARATION REQUIREMENTS

Where cable is attached to power poles that also support open wire telephone crossarms, the cable should be attached to the poles under the lowest crossarm to minimize the possibility of open wires swinging against the cable strand which is grounded. The final unloaded sag of cable and strand, especially in long span construction, generally is greater than the maintenance sag for open wires in the same spans.

- 4.5 Among the MESC requirements which should be observed are those relating to the location of vertical cable runs on poles, such as for underground feeds, dips and pole mounted cable terminals and loading coils.
- 4.6 Secondaries on power poles usually are below the neutral wire and generally are of such size that they are installed with the same sag as the neutral wire. The lowest secondary is assumed to be attached to poles 3 feet below the neutral wire. The data sheets provided herein are based on these assumptions.
- 4.7 REA TE & CM-690 in paragraphs 4.31 to 4.37 states in detail the requirements for vertical separations of circuits at the supports and in spans. Briefly stated these requirements are:
 - 4.71 Minimum vertical separation at the supports between telephone

circuits and power conductors of less than 8700 volts betwee conductors is 40 inches. This includes separation from post transformers.

- 4.72 Minimum vertical separation at the supports between telephor circuits and power conductors of more than 6700 volts between conductors is 63 inches.
- 4.73 Minimum vertical separation in spans between telephone circuits and power conductors of less than 8700 volts between conductors is 30 inches.
- 4.74 Minimum vertical separation in spans between telephone circults and power conductors of more than 8700 volts between conductors is 45 inches.
- 4.75 Other requirements are that (1) telephone circuit attachmen on poles shall be adjusted so that at 60°F and no wind, no secondary (0-750 volts) shall hang below a straight line of sight between telephone circuit attachments on adjacent pol and (2) no power conductor of more than 750 volts shall be lower than 30 inches above this line of sight. This applie even though a neutral is below the power conductors. The neutral in this case is covered by paragraphs 4.71 and 4.73 above.
- 4.8 The minimum permissible ground clearance for power wires along roin rural areas under NESC rules usually is 18 feet basic, but this may be reduced to 15 feet basic where the ground under the line is will be traveled except by pedestrians.

Communication conductors (including cables) require 14 foot basis ground clearance in the same rural areas but may be 13 feet basis if not overhanging traveled portions of the road or 8 feet basis where the ground under the line will never be traveled except by pedestrians. Data herein covers basic ground clearances of 8, 10 12 and 14 feet for telephone cable and assumes 15 foot minimum powers ground clearance.

- 4.9 REA TE & CM-635 includes strand stringing tension and sag data at 20°, 60° and 100°F for 6M, 10M and 16M strands. Figure 1 herevigives strand stringing sags at 60° for 6M and 10M strand.
- 4.10 Initial sag curves at 60°F and final sag curves at 120°F for cab. weighing .25 to 1.0 pounds per foot with 6M and 10M strands are given in Figures 2 to 7, inclusive, for the heavy, medium and liploading areas. The 120°F sag curves are given because this give the greatest sags that are likely to occur in hot weather.

CLUMIEG REMER ROUTELESSES

- 5.3 Where two is more cables are attached to a good pole they shall be on the same stan of the pule to comply with MMC climbing space requirements.
- 5.4 Cables preferency shall be attached on the same side of the pole as the power neutral wire.

MECTRICAL PAYMETICH HERITEPAGES

6.3 The requirements of Mark the Carlie, "Cable furcuit Protection" should be complicit with. In brief, these requirements are that cable sheaths or shields be boated to the Man of the power system via the support strand and a vertical pole ground vire (1) at the beginning and end of the joint use section; (2) at one mile intervals (if the section is more than 15 addes in length); and (3) on every electric supply pole that carries a verticul pole ground vire to which is connected transformers, capacitors, or other types of power equipment that drew load current under normal conditions. In addition to the shows grounding boads the cable sheath or shield should be electrically connected to the carties office ground.

LEDUCTIVE COORDINATION

7.4 REA TE & CM-45(), "Inductive Coordination - Telephone Circuit Boise Due to Induction from Electric Person Lines," should be consulted particularly as to the relative ments of cable on joint poles with power circuits versus cable on a pole line at highest separation from the power line.

ECCECATC COMMIDENATIONS

8.5 Where more than the poles per alle require replacement or pole inserts to permit joint use for cable, the project is doubtful economically. Cost studies should be made in any swent as outlined in MA 72 & CM-205, "Propagation of an Area Countage Design," and MA 72 & CM-218, "Plant Annual Cost Data for System Design."

SAFETY COMBUDERATION

9.6 Telephone linears should not work in power space above communication space on joint use poles. Vertical pole ground wires on electric supply poles that are interconnected to transformers or capacitor banks should be connected directly to the power system neutral. The transformer or capacitor banks should also have direct connections to the power system neutral. At such locations visual inspection from the ground should be made before climbing, to escertain that the vertical pole ground wire is actually connected to the neutral. If it is not connected. This fact should be reported to

- the power company and the wire should be regarded as energized. The pole should not be touched or climbed by telephone linemen until the condition has been corrected by the power company.
- 9.7 When suspension strand is installed it has much less sag than after cable is placed on it. Power wires have considerable sag in long span rural construction. Consequently, it may be necessary to attach the suspension strand temporarily at a point below its final attachment point to prevent contact with power wires above it on the same poles until cable is placed on the strand. The temporary location should keep the strand at mid-span below the lowest power wire attached to the poles above the strand. The temporary means of attachment can be by driving ing bolts into the poles or by placing other suitable support nardware at proper height to give the temporary clearance. Washers can be placed on the bolts and the strand can be placed on the boits between the washers and poles. The strand then can be secured to the poles with .109 inch steel line wire to hold it-temperarily until after the cable is supported by the strand. The strand and cable then can be raised to the throughbolts and the strand attached by three bolt cable clamps in the standard manner.
- 9.8 The curves of sags for strand only and for strand with cable in place can be used to determine the temporary location of the strand on the poles. For example, a 6M strand when installed will have about 2.5 feet of sag in a 300 foot span at 60°F. A cable weighing .5 pounds per foot on this strand will increase the sag to nearly 5 feet. Therefore in this case the strand should be placed 2.5 feet below its final location, assuming that this point is to bring the cable at mid-span to a point 30 inches below the lowest pole attached power wire.
- 9.9 Safety considerations dictate that cables be lashed in joint use construction from the ground rather than by a man riding the strand to handle the lashing machine.
- 9.10 Strand should be grounded at all times during installation and permanently bonded to the neutral power wire immediately after stringing.
- 9.11 In long spans intermediate poles between power poles to support the cable but not the power wires create an electrical hazard and should be avoided.
- 9.12 Telephone linemen may make bonding connections to vertical pole ground wires in communication space on joint use poles. If no vertical pole ground wire exists on a pole on which a grounding bond is required, sufficient bonding wire to reach and connect the MGN shall be left coiled and taped two feet above the cable. Attachment of this wire in electric supply space on the pole and

CLEANING SPACE MODELLE CLEANING

- 5.3 Where two or more cables are attached to a gover pole they shall be on the same and of the pule to comply with WEEC climbing space requirements.
- 5.4 Cables haviorship shall be attached to the same side of the pole as the prior neutral wire.

NIZOTRICAL PROTECTION HEROTERNISTS

LEDUCTIVE COORDINATION

7.4 REA TE & CM-450, "Inductive Coordination - Telephone Circuit Moise Due to Induction from Electric Power Lines," should be consulted particularly as to the relative merits of cable on joint poles with power circuits versus cable on a pole line at highesty separation from the power line.

ECOSOMIC CONSIDERATIONS

8.5 Where more than text poles per sale require replacement or pole inserts to persit joint use for cable, the project is doubtful economically. Cost studies should be sade in any event as outlined in SMA THE & CM-205, "Propagation of an Area Country Design," and NEA THE & CM-218, "Plant Annual Cost Data for System Design."

SAFETY COMBUTERSATE TO AND

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- the power company and the wire should be regarded as energized. The pole should not be touched or climbed by telephone linemen until the condition has been corrected by the power company.
- 9.7 When suspension strand is installed it has much less sag than after cable is placed on it. Power wires have considerable sag in long span rural construction. Consequently, it may be necessary to attach the suspension strand temporarily at a point below its final attachment point to prevent contact with power wires above it on the same poles until cable is placed on the strand. The temporary location should keep the strand at mid-span below the lowest power wire attached to the poles above the strand. The temporary means of attachment can be by driving ing bolts into the poles or by placing other suitable support nardware at proper height to give the temporary clearance. Washers can be placed on the bolts and the strand can be placed on the boils between the washers and poles. The strand then can be secured to the poles with .109 inch steel line wire to hold it-temperarily until after the cable is supported by the strand. The strand and cable then can be raised to the throughbolts and the strand attached by three bolt cable clamps in the standard manner.
- 9.8 The curves of sags for strand only and for strand with cable in place can be used to determine the temporary location of the strand on the poles. For example, a 6M strand when installed will have about 2.5 feet of sag in a 300 foot span at 60°F. A cable weighing .5 pounds per foot on this strand will increase the sag to nearly 5 feet. Therefore in this case the strand should be placed 2.5 feet below its final location, assuming that this point is to bring the cable at mid-span to a point 30 inches below the lowest pole attached power wire.
- 9.9 Safety considerations dictate that cables be lashed in joint use construction from the ground rather than by a man riding the strand to handle the lashing machine.
- 9.10 Strand should be grounded at all times during installation and permanently bonded to the neutral power wire immediately after stringing.
- 9.11 In long spans intermediate poles between power poles to support the cable but not the power wires create an electrical hazard and should be avoided.
- 9.12 Telephone linemen may make bonding connections to vertical pole ground wires in communication space on joint use poles. If no vertical pole ground wire exists on a pole on which a grounding bond is required, sufficient bonding wire to reach and connect the MGN shall be left coiled and taped two feet above the cable. Attachment of this wire in electric supply space on the pole and

and competion to the Mil must be done by purer company linemen.

O. DEFENDINATION OF POLE REPLACEMENT LEGULARD THE RELIGIOUS PORTA FOLE LINES

- 10.52 Reference should be made to the REA TE & CH-690 paragraphs under this beading. In this effective the vertical separation data are given in AD Figures 64 to 98 inclusive for cable placing.
- 10.53 The following examples are provided for use in determining the practicability of joint use for cable:

Example Bo. 4:

Conditions:

Cable Size 25 pr., 22 ga. plastic shoath

and insulation.

Loading District Heavy

Cable Ground Clearence 8 feet

Average Span Length 300 feet

Ground Level

Power Pole Height 30 feet

Pole Class 6

Secondaries Mono

Power Wires 4-7/1 ACER

Power Wire Configuration Single Place, 2 Wire

Voltage 7200 volts

Froposed Suspension Strand 6M

Ruling Span Longth 325 feet

Solution:

Step 1. Cable Weight - .209 lb. per foot. Consider it to be .25 lb. per foot.

Step 2. Table 1 shows that this 25 pr. 22 ga. cable can be used on the strand for average spans up to 325 feet in beavy loading.

- Step 3. Power neutral wire point of attachment above ground on 30 ft. pole is 21 feet.
- Step 4. Power wire final sag in a 300 ft. span where ruling span is 326 feet is 3.5 feet (Figure 8).
- Step 5. Initial sag of .25 lb. per foot cable on 6M strand, 300 ft. span, heavy loading, is 3.5 feet (Figure 2).
- Step 6. Final sag of .25 lb. per foot cable on 6M strand, 300 ft. span, heavy loading is 6.0 feet (Figure 2).
- Step 7. Because the initial sag of the cable will be equal to the final sag of the power wire (3.5 ft.) the cable can be attached 3.5 feet below the power wire point of attachment. This point is 21 minus 3.5 which is 17.5 feet above ground.
- Step 8. With the cable attached 17.5 ft. above ground and final cable sag of 6.0 ft., the ground cherance at mid-span on level ground would be 11.5 feet.
- Step 9. The attachment of the cable can be 3.5 feet below the point of power neutral attachment per Step 6 above. The cable equates to approximately 4 open wires per paragraph 3.5. The 4-7/1 ACSR power wire dismeter is .257 inches (approximately .250 in.). Reference to REA TE & CM-690, RD Figure No. 2 for "2 power conductors" and "4 communication conductors" can be carried safely in 300 ft. spans by a Class 6 pole in heavy loading.

Example No. 5:

Conditions:

Cable Size 75 pr., 22 ga. plastic sheath

and plastic insulation.

Loading Area Medium

Cable Ground Clearance 8 feet

Average Span Length 350 feet

Ground Level

Power Pole Reight 35 foot

Pole Class 7

Secondaries

Moneo

Power Conductors

5-7/1 ACST

Power Configuration

Single Phane, 2-vire

Voltage

7200 witte

Proposed Strand

6M

Ruling Span Length

425 feat

Solution

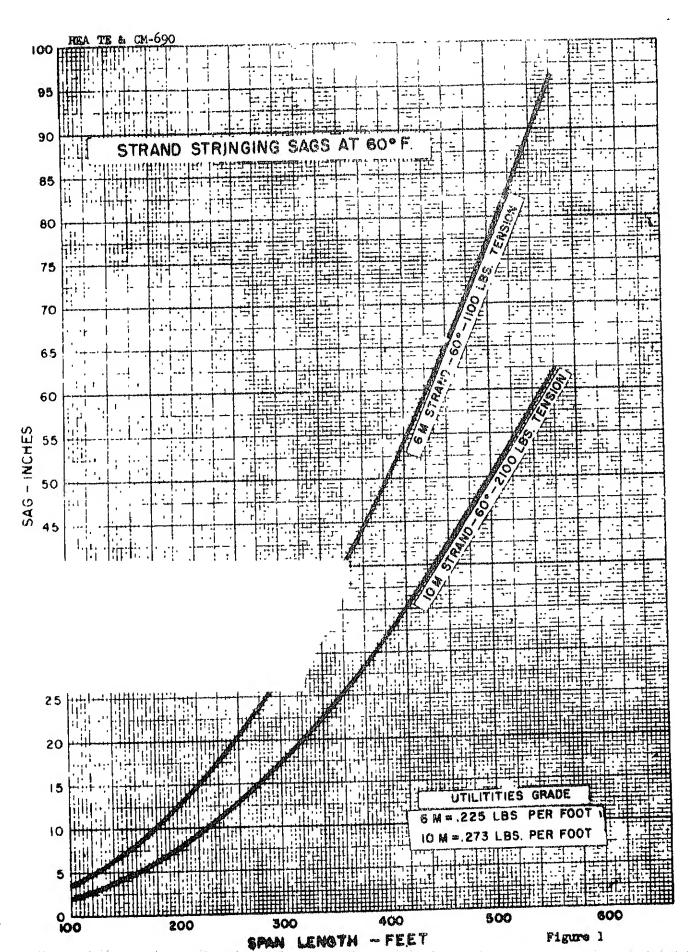
Step 1. Cable Weight - .50% lb. per foot. Consider at to be .5 lb. per foot.

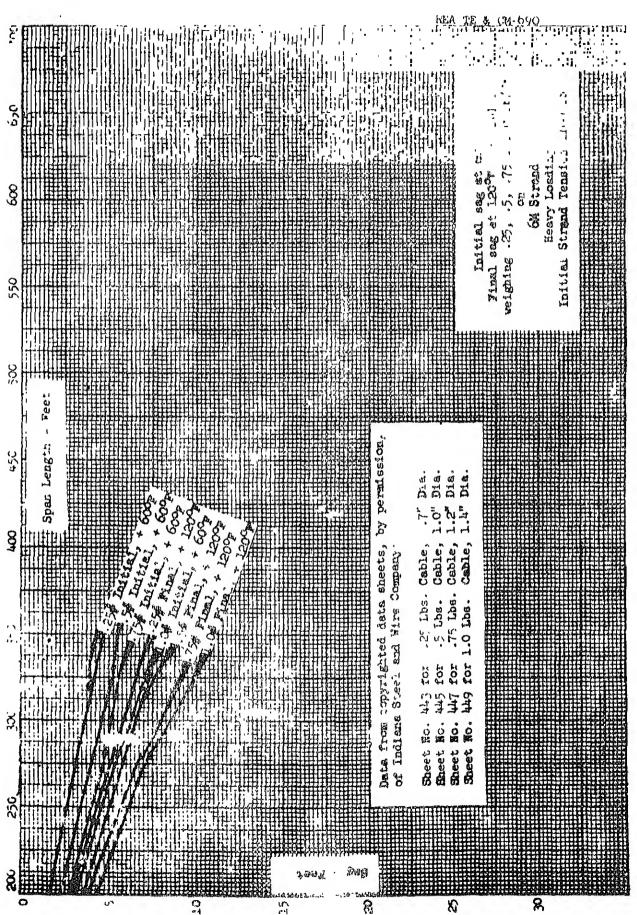
- Step 2. Table 1 shows that 75 pr., 22 gauge (.5 lb) cable on 6M strand can be used for average spans up to 600 feet in medium loading.
- Step 3. Power neutral wire point of attachment above ground on 35 ft. pole is 25.5 feet.
- Step 4. Power wire final sag at 350 feet where ruling span is 425 feet is 3.0 feet (Figure 12).
- Step 5. Initial sag of .5 lb. per ft. cable on 6M strand, 350 ft. span, medium loading is 6.0 feet (Figure 3).
- Step 6. Final sag of .5 lb. per ft. cable on 6M strand, 350 ft. span, medium loading is 7.75 feet (Figure 3).
- Step 7. The carle must be attached to the pole at least 3.5 feet below the neutral wire. Because the initial cable sag (6 feet) is greater than the final sag of the neutral wire (3 feet) the cable will not violate the 2.5 foot required separation at mid-span. The cable attachment point will be 25.5 less 3.5 which is 22 feet above ground.
- 8tep 8. The cable final sag of 7.75 feet means its final ground clearance will be 22 minus 7.75 which is 14.25 feet at mid-span. This fulfills the 8 ft. desired ground clearance requirement.
- Step 9. The point of attachment of the cable will be at 22 ft. above ground which is 3.5 feat below the neutral wire attachment point (call it 4 feet). The cable equates to 6 open wires

per paragraph 3.5 in the medium loading area. The 4-7/1 ACSR power wire diameter is .257 in. (approximately .250 in.). Reference to Section 690, RD Figure No. 7 for "2 power conductors" and "6 telephone conductors" shows that a class 7 pole will safely carry the combined load in 350 ft. spans in the medium loading area.

11. STAKING OF JOINT USE LINE

11.6 Reference should be made to the REA TE & CM-690 paragraphs under this heading. In this addendum the staking tables are given in RD Figures 99 to 118 inclusive.

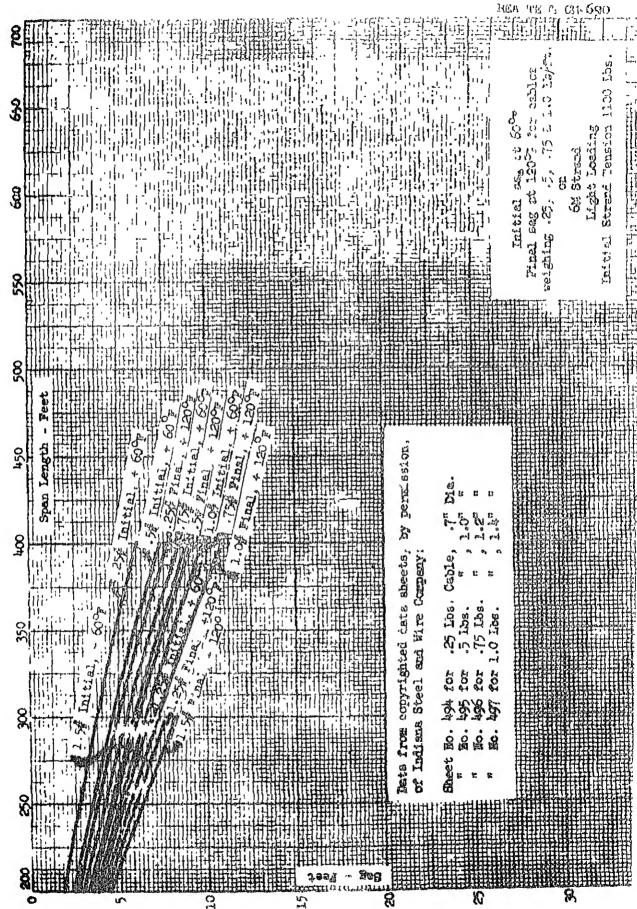




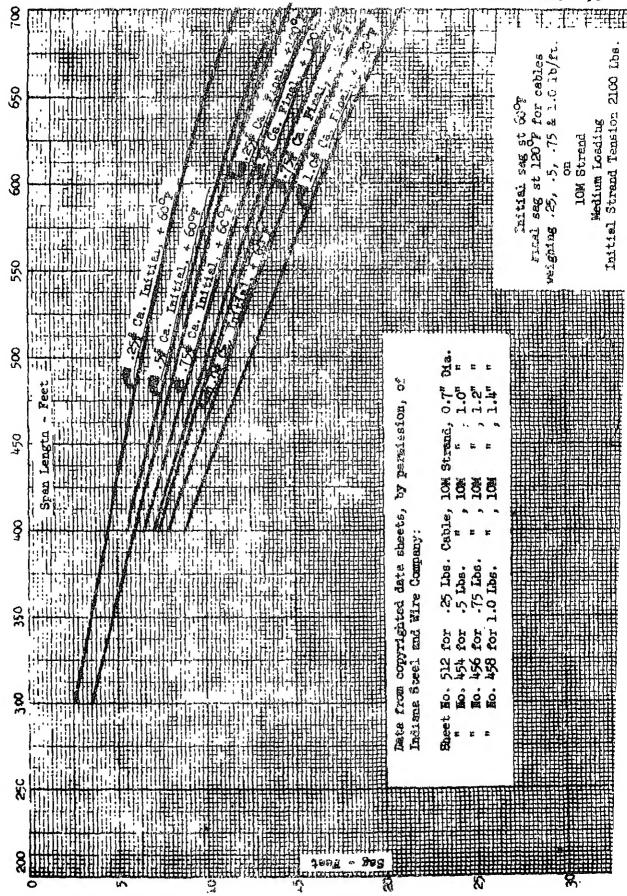
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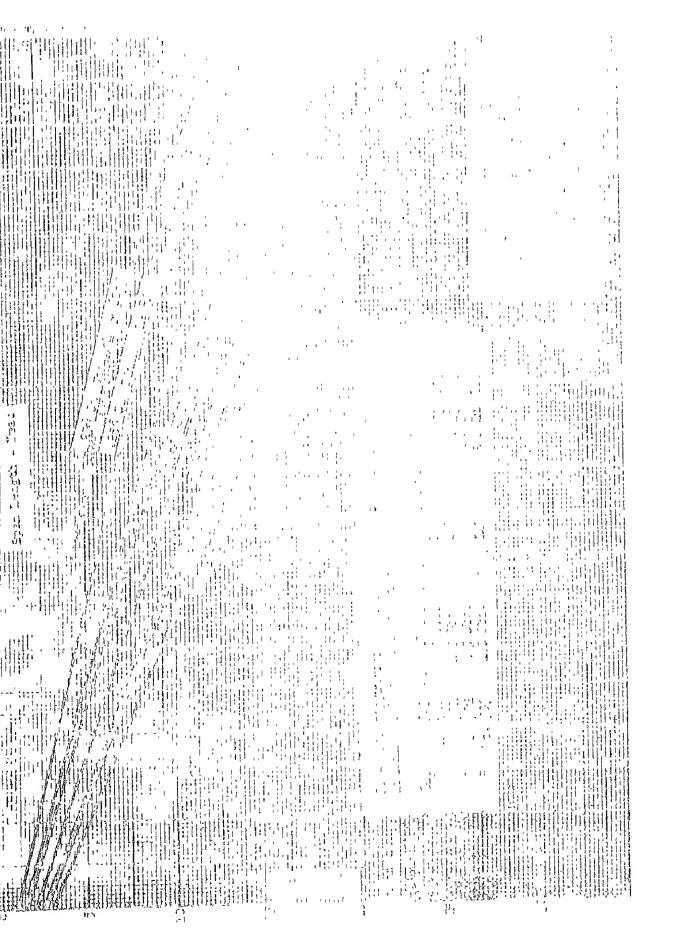
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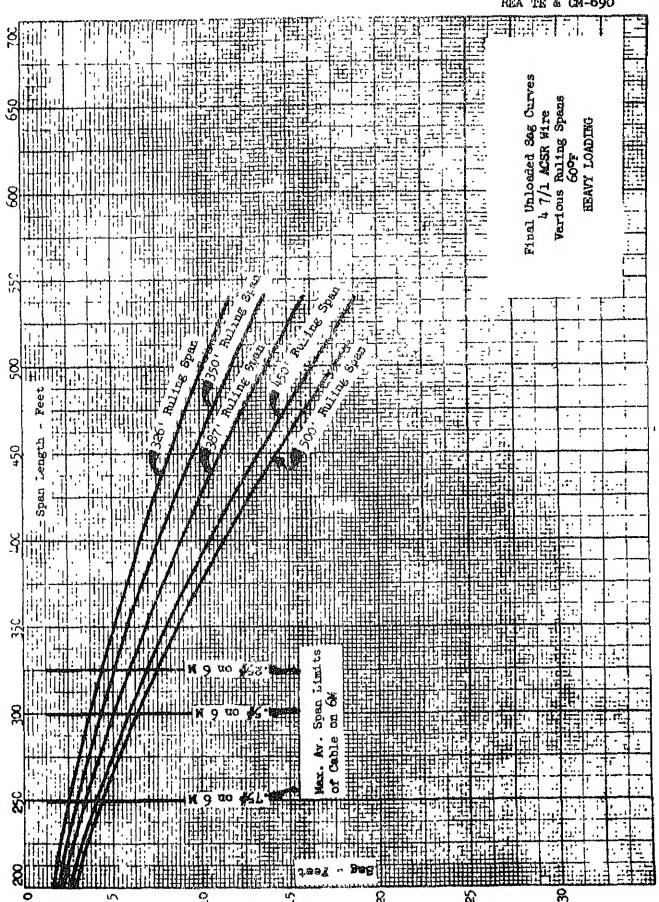
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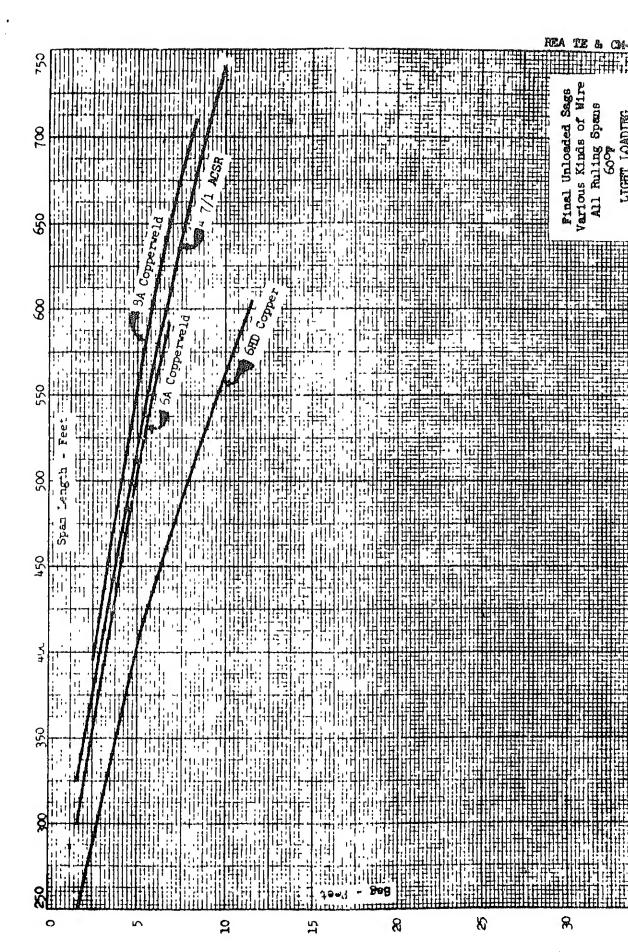


Figur 31

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VERTICAL SEPARATION TABLES FOR TELEPHONE ENDERSUILD ON REA ELECTRIC POLE LINES - Foet

LOADING DIGTAICY POUCE COMBUCTOR

TELEPHONE CONSUCTOR

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2 30-inch minimum midupum separation between highest telephone conductor and neutral or secondaries.

3. Line of night rule when acconduction up to 750 volte are involved.

4. All separations are based on REA pole head configurations with soutral 3% feet below pele top and phase eires accupying a position at top of pale and levest accondary 3 feet below neutral.

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3. Line of night rule when decenderies up to 750 volto are involved.

^{2. 30-}inch missions sidepes separation between highest telephone conductor and neutral or secondaries.

^{4.} All separations are based on RSA pole bond configurations with neutral 3% foot below pole top and phase wires occupying a position at top of pelo and levest considery 3 feet below neutral.

RD-Flaures Mos 66

VERTICAL SEPARATION TABLES FOR TELEPHONE UNDEREUILD ON REA ELECTRIC POLE LINES - Feet

LOADING OFBTRIET

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^{2 30-}inch minimum midepun separation between highest telephone conductor and neutral or secondaries.

Line of eight rule when secondaries up to 750 volto are involved.

⁴ All separations are based on REA pole head configurations with neutral 3% feet below pele top and phase wires escupying a position at top of pole and l'event secondary 3 feet below seutral.

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has of sight rule show acconductor up to 750 volta are involved. Il separatione ere based on REA pele hand configurations with neutral 3% feet below

ste tep and phase wires accupying a position at top of pale and lowest secondary 3

tet below moutral RD-Figure No. 68

VERTICAL SEPARATION TAGLES FOR TELEPHORIE EMBERGIALD CO REA FLECTBIC POLE LINES - FOOT

LOADING DIGVEIST PEOSE COMPACTED

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- 40-inch minimum apparation at pole between neutral or secondary and highest telephone conductor. (These tables do not include any consideration of minimum separation requirements when power equipment is neunted on pole below the neutral).
- 3 30-inch sinium midepon deparation between highest telephone conductor and neutral or secondaries.
- 2. Line of sight rule when acconduction up to 780 voits are involved.
- 4. All separations are based on REA pole head configurations with neutral 3% feet below pole top and phase wires accupying a position at top of pole and boundt secondary 3 feet below neutral.
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CONTICAL DEPARATION TACLED FOR MILEPHONE CHRESHILD ON REA ELECTRIC POLE LINES -- Feet

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3 Line of sight rule when cocenderion up to 780 velts ure involved.

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^{2 30-}inch minimum midepon apparation between highest talephone conductor and neutral acconductor.

^{4.} All separations are based on REA pole hand configurations with neutral 3% feet bale pole top and phase wires corupying a position at top of pole and breast essendary 3 feet balow neutral.

VENTICAL DEPARATION VADLES FOR TELEPHONE UNDEREUILD

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^{1 40-}inch minimum separation at polo between neutral or secondary and highest telephone conductor (These tables do not include any consideration of minimum superation requirements when power equipment is accusted on pole below the neutral).

³⁰⁻inch minimum midepan apparation between highest telephone conductor and neutral or

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t. All separations are based on REA pole head configurations with neutral 3% foot balov pole top and phase circs occupying a position at top of pole and lawest secondary 3 foot below neutral

VERTICAL BEPARATION TABLES FOR TELEPHORE WIDERSHILD ON ARA ELECTRIC POLE LIERS - Peet

LOADING DISTRICT POUR COMMUNETOR

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The date shown in this table reflect the fellowing basic minimum requirements: 1. 40-inch minimum seperation at pole between neutral or seasedary and highest talephone conductor. (These tobles do not include any consideration of minimum experation requirements when power equipment is nounted on pole heles the neutral).

30-inch sinium sidepen constraint between highest telephone conductor and neutral or **conderice

3. Line of sight rule when cocenderies up to 780 volts are involved.

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4 All separations are based on REA pole head configurations with neutral 3½ feet below pale top and phase wires occupying a position at top of pole and become semendary 3 foot below neutral.

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³⁰ lack minimus misspon emparation between highest telephone conductor and neutral or

Line of eight rule when acconduction up to 750 volts are involved.

All separations are based on NEA pole head configurations with neutral 3% fact below pele tep and phase sires occupying a position at top of pele and lovest secondary 3 HO-Plance No. 74 foot beles seutral

VERTICAL OFFARATION TABLES FOR TELEFRONE UNDERLUILD OH BEA ELECTRIC POLE LINED - Meat

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390	5.0	9.5	6.0	10.5	7.0	11.5	8.5	13.0	9.5	14	
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^{2. 30-}tack minimum midopen separation between highest telephone conductor and neutral or secondaries

^{3.} Line of eight rule when decemberias up to 750 velts are involved.

^{4.} All separations are based on REA pole head configurations with neutral 3% foot below pole top and phase viras ecoupying a position at top of pole and lowest secondary 3 feet belev seutral.

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WERTICAL SEPARATION TABLES FOR TELEPHONE UNDER SUILD on REA ELECTRIC POLE LINES - Feet

LOLDING DISTRICT PODER COMPUETOR ,

4 7/1 ACER TELEPHONE CONDUCTOR

the consequence are present or planted, use notion "Securiary".

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410	6.0		7:0-	11.5	8.5	13.0	10.5	15.0	11.5	15.5
420		10-1-		12.0	9.0	13.5	11.0	15.5	72.0	16.0
430	6.5		7.5		9.5	74.0	11.5	16.0	72.5	17.0
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NOTER: The dat shown in this table reflect the following basic minimum requirements: 1. 40-inch minica separation at pole between neutral or secondary and highest telephone conductor. If one tables do not include any consideration of minimum separation requirements .) a power equipment is neunted on pole heles the neutral).

2. 30-lach min. an midspen seperation between highest telephone conductor and neutral or secondaries.

3. Line of sigh rule then acconderies up to 750 velts are involved.

4. All esparations are based on REA pole head configurations with neutral 3% foot below pole top a phase wires eccupying a position at top of pole and levest secondary 3 RD-Figure No. 73 fost boles 'sutral.

PERTICAL SEPARATION VALLED FOR VELICIAL IN ULDER, "ILLE en aga gleevoie pell lides . Milio

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The deto shows is this table reflect the following basic minimum requirements. COTES. saparation at polo between noutral or secondary and highest telephone (These tables do not include any consideration of minimum separation requirescate when power equipment to nounted on pole being the neutral).

10 lack minimum midepen coparation between highest telephone conductor and moutral or

Line of eight rule when secondaries up to 930 volta are involved.

All separations are based on REA pair head appliquentions with neutral 3% feet bolov pele tep and phase stree eccupying a position at top of pole and league accordary 3 foot below neutral. MD-Figure No. 78

VERTICAL SEPARATION TARLES FOR TELEPHORE UNDERCUILD OR REA (LECTRIC POLE LINES - Freet

LOADING DISTRICT

PODER CORGUETOR

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Heavy Pere cocodation are present or planed, use column "Georgiary" All essareticas chorn are between sentral and telephone condenters. .25 Ca. on 104 Str BIBINAN DESAUVIOR VA SOFE SELACED SONTE REGLEVY VOG LETENNUE COURTELLUS SPAM 354 BULING SPAN 375 RULING SPAN 416 BULING SPAN 450 BULING SPAN AULING LEMETH LOWER POWER COND. LOWER POWER COMD. LOWER POWER COMO. LOMER POWER COND. LOWER POWER CO MAUTEAL 01 CONBARY MEUTAAL BECOMBARY HEUTRAL BECOMBABY BEUTRAL BECOMBARY BEUTHAL 200 210 220 230 240 250 260 270 280 290 300 6,5 8.0 3.5 5Ω 310 8.5 7.0 320 H 91 11 20 M 16 8.0 2 330 Ħ Ħ 8.5 5.5 9.0 7.0 140 4 幫 14 مما 5.0 150 u 11 8,0 0.0 10.0 7.5 360 370 H 41 8.0 8.5 9.5 6.0 10.5 180 M 24 5.5 DOL 11.0 390 6.5 A.O 8.5 4.5 9.0 10.5 6ω Ħ 400 5.0 9.5 6.5 Darr 7.0 11.5 410 -4.5 12.0 9.0 7.5 4.20 14 14 10.0 7-0 11.5 Bag 12.5 430 Ħ 8.5 5.0 9.5 6-0 7.5 12.0 OFF 440 12 B.Q 12.5 10.0 9.0 5-5 10.5 13.5 450 6.5 10.0 11.0 13°0 460 14.0 11.5 470 10.5 14.5 9.0 13.5 480 D. RE 9.5 0 مار JJ_Q 15.0 7.5 490 15.5 10.5 500 510 520 530 540 550 560 570 580

HOTKS: The data shows in this table reflect the following basic wishman requirements 1 40-inch minimum separation at pole between neutral or necondary and highest telephone conductor. (These tables do not include any consideration of minimum separation requirements when power equipment is mounted on pole below the neutral).

590

^{2 30} inch minimum midspon separation between highest telephone conductor and neutral a

³ Line of eight rule when secondaries up to 750 volts are involved.

⁴ All separations are based on REA pale head configurations with neutral 3% feet bales pele top and phase wires occupying a position at top of pele and lowest secondary 3 feet below neutral

WANTICAL BEPARATION TACLED FOR TELEVISIAE CONFIGUILO EN MEN ELECTRIC POLE LINES . Teet

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tines assessmetes ere protect or picanes, use withen "Beenstatey". All Paratalago chem ore bateato aratral cod telephone conductors 54 Cas on 10M Attends HIDINUN COPADATION AT POLS SLYHEGE POURS HEUTAAL AND TELEPHORE CONDUCTORS BULING SPAN 375 RULING SPAN 1400 QULING SPAN 1450 PULING SPAN BOAS 145 RULING SPAN HT GADA LOWER POWER COND. LOYER PORER COUD. LOTAR POSTO COMO. LOWER POHER COND. LOUGA POWER COMO JAPFUDE BECOMBANY BOUTBAL BECORDABY VARCESSAR HOUTBAL MEUTRAL BRCONDADY HEUTOAL VIRCOMPARY 200 210 220 330 260 254 1.0 280 ø 99 7.5 270 Ħ 1 17 Ħ 7-0 de t H ., 260 43 44 18 11 8:0 5 16 80 290 Laca 7 5. 11 ħ r.i 300 17 • Jul. 4 8.5 11 31 310 9.0 Ħ w M 8,0 230 1) 3n5 Ű 15 340 35 k ź 540 La O Cessi LOLO į., ir 3 16 H 11 5.0 ميڌ. Jak 10.5 330 N 6.0 2.0. $a_{\rm g}$ al 370 25 Was a 7.0 fđ er 390 10.5 12.0 L.O B.O 11 II.O 390 12.5 Maria 655Jinh 400 7.0 11.5 8.5 13.0 J.Q $Q_{\mathbf{L}}$ 10.5 410 13.5 9.4 11.0 7.5 12.0 200 9.0 630 Ball 9.5 12 14.0 431 5.5 10.0 Lass 11.5 12.5 ممد 447 8.5 14.5 0.0 12.0 D.F.L 10.5 سند الله 11 450 Bail 12.5 9.0 13.5 מרנ Tra 464 Baja 15.5 J. .. ^ 11.5 470 10.0 12.0 17, (1 14.5 400 12.5 16.5 10.5 _بر_مالي ممولد 11 43 Julian 4 50 17.0 18.0 12:0 12.0 13.5 المسلمان 500 Illani 11.5 i Oan 1.11 520 150 341 311 566 1/1 *AC 590

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³ Line of eight rule shen seconderies up to 750 volts are involved.

^{6.} All apparations are based on REA pole head configurations with neutral 3% feet boles pole top and phase vises ecoupying a position at top of pole and lovest necessary 3 foot boley newtral. FD-Figura 10. TT

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ach minimum midspan separation between highest telephone conductor and neutral or

HD-Figure No. 82

ach minimus aldspan separation betreen highest telephene conductor and nautral e ndaries

of eight rule shee seconderies up to 750 volts are involved

separations are based on REA pole hand configurations with neutral 3% feet below top and phase vires occupying a position at top of pole and lovest accordary 3 below wented

VZOYICAL OWPAGATION TABLED FOR TELEPHONE EMORACUILD ON DEA ELECTRIC POLE LINES FRONT

LOADING DISTRICT POURS CONDUCTOR

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Page accordance are product or planes use colers Gossidery" All Heavy

25 # Ca. on 10M Strand ecorotico e de la levisión de la contractica en cueda ecolores MINIMON DEPARATION AT POLE DETMEN POWER HEUTRAL AND TELEPHONE CONDUCTORS 400 BULING SPAN 450 RULING SPAN 345 BULING SPAN 375 BULING SPAN RULING SPAN LBESTM LONSO POLSO COMO. LOSER POWER COMO. LOWER POWER COND. LOWER POWER COND LOWER FORER COMO BEUTGAL SE COUGARA HOUTOAL BECOMDARY REUTOAL BECGROABY REUTHAL RECOMBARY REUTBAL SE CONBARY 300 210 220 230 240 250 260 270 260 290 4.5 8.0 8.5 300 4 . Q 7.0 410 7.5 5.0 6.0 9.0 11 320 8.0 $7_{\bullet}Q$ 8.5 9.5 D 얾 st 51 310 24 14 10.0 2.0 14 ㅂ Ħ Ħ 340 ئہ8 5.5 6.5 350 63 Ol 52 11 9.5 10.5 300 £F 14 Ħ 11.0 2000 8.0 2.0 5.0 370 4ω 9.5 6.0 7.5 17.5 480 DI 11 5 مل 10.5 12_0 **F** 340 81 5.4 20.0 مملا B.O 12.5 400 8.5 13.0 9-0 6.0 10.5 7.0 11.5 410 7.5 12.0 Jug C 6.5 11.0 9.0 13:5 9.5 4:30 4 30 8.5 14.0 بامنا 12.5 $T_{\mathbf{A}}Q$ 10.0 $\Omega_{\alpha}\Omega_{\beta}$ 440 10.5 61 74.9 $\Omega_{\alpha}\Omega$ 7.5 12.0 13.0 10.5 41,0 13.5 11.0 15.5 0.8 12.5 9.0 460 14.0 11.5 16.0 يتملك JAR 13.0 470 7.0 11 14.5 12.0 16.5 11.5 2.0 10.0 480 11 13.5 H 17.5 9,5 490 12.0 ريا 0.0 11.5 10.0 14.5 14.0 18.5 500 12.5 510 520 550 540 550 560 970 ',80

NOTES: The data shows in this table reflect the following basic minimum requirements?

1 40-lack minimum separation at pole between neutral or secondary and highest telephone conductor. (These tables do not include any achievantion of minimum separation requirements oben power equipment is neumted on pole below the neutral).

590 600

^{2 30} toch minimum midepan esparation between highest telephone conductor and neutral or secondaries

I Line of eight rule shen secondaries up to 750 volts are involved

⁴ All deparations are based on NEA peld head configurations with neutral 3% feet below pole top and phase wires occupying a position at top of pele and lovest seasadary 3 feet below asstral.

RD-Figure No. 79

OJECT BENEVELLE BOY OBJOAT COLFARADO LASITEST OF CHIEF - FOOT

LOADING DIOFRICY POORS COMMUNICATION

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VERTICAL REPARATION TABLED FOR TELEPHONE EMBERRUILS on has alsomic Pole Links - Foot

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List of sight suit when percentarios up to 750 value are involved.

^{2 30-}inch minimum midspun separation between highest relephane conductor and neutral a secondortes.

⁴ Ail separations are based on REA poly hard nonfigurations with moutral 3% foot below pole top and phase virus countries a position at top of pole and, lovest accordary 3 feet beles sentral. RR-PLEUTO A

UNITION OF BEAUTIES FOR BUILDAY COLVADABLE LANGUESTERS on all electric fore lines West

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HD-Figure No. 86

separation at polo between soutral or senendary and highest telephone conductor. (These tables do not include any consideration of minimum separation requiremento when perer equipment to asserted on pole beion the neutral?

³⁰⁻tach slutuus eidepen asparatlen between highest telephone conductor and neutral or

Line of eight rule when neconderies up to 780 velts are involved

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³⁰⁻incb minious midspen separation between bighout telephone conductor and neutral

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VERTICAL SEPARATION TABLES FOR TELEPHORE (SIGERCY) LD OR REA ELECTRIC FOLE LIBES - FORT

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^{#0718} The data shows in this table reflect the following basic minimum requirements:

1 40 inch minimum separation at pole between neutral or secondary and highest telephone
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2 30 inch minimum mideres separation between highest telephone conductor and neutral or

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3 time of eight rule when seconderies up to 750 voits are involved.

⁴ All seperations are based on REA pole hood configurations with newtral 3% feet below pale top and phase virus accupying a position at top of pole and lowest secondary 3 feet below neutral

WERTICAL DEPARATION TABLES FOR TELEPHONE UNDERGUILD on all cleeraic pole lines - Feet

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^{2 30} inch minimum miderum neparation between highest telephone conductor and neutral or

³ Line of eight rule when secondaries up to 750 velts are involved

⁴ All separations are based on REA pole boad configurations with soutral 3% feet below pale top and phase wires eccupying a position at top of pole and lovest seashfary 2 toot below soutrai

VERTICAL ESPARATION TABLES FOR TELEFORIS UNDESCRIBED GO GEA ELECTRIC POLE LINES - Feot

LOADING BIBTOICT FORES CONGUETON

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^{2 30} and minimum midspon separation between highest telephone conductor and neutral or

³ line of aight rule when secondories up to 750 volts are involved

⁴ Atl asperations are based on REA pale hoad configurations with neutral 3% feet below pole top and phase wires occupying a position at top of pele and levest necessary 3 feet below neutral RD-Figure No. 90

VERTICAL SEPARATION TABLES FOR TELEPRODE UNDERWILD GA GLA ELECTRIC POLE LIMES - Feet

LOADING DIDVOICT

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⁴ All separations are based on REA pole head configurations with neutral 3% feet believes top and phase wires occupying a position at top of pole and lovest secondary feet below neutral

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3 Line of eight rule when secondaries up to 750 volts are involved.

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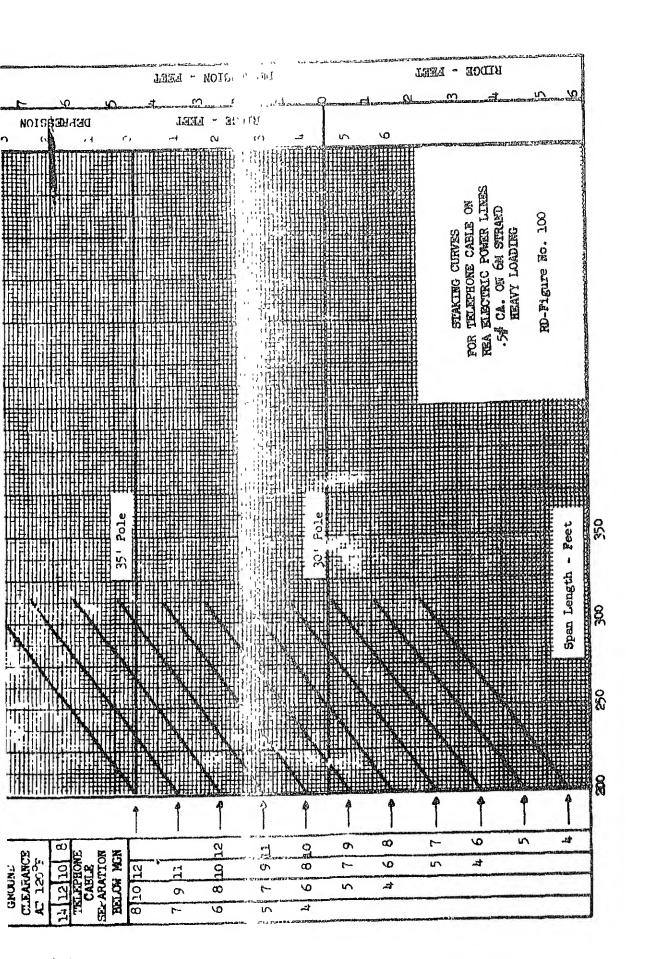
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The data shoun in this table reflect the following besix minimum requirement 1 40-inch minimum appearation at pole between moutral or accordary and highest tole conductor (Those tables de not include any densideration of minimum separation quirenents when power equipment is neunted on pelo heles the newtrell.

Line of sight rule when acconducted up to 750 volto are involved.

U lack minimum midspen separation between highest telephone conductor and nout

^{4.} All separations are haved on REA pole head configurations with montral 3% foot pole top and phase sires escapying a position at top of pole and levest seconds foot balow neutral. RO FLA



PERFECAL DEPARATION TABLES FOR TELEPHONE EMPERALIZA

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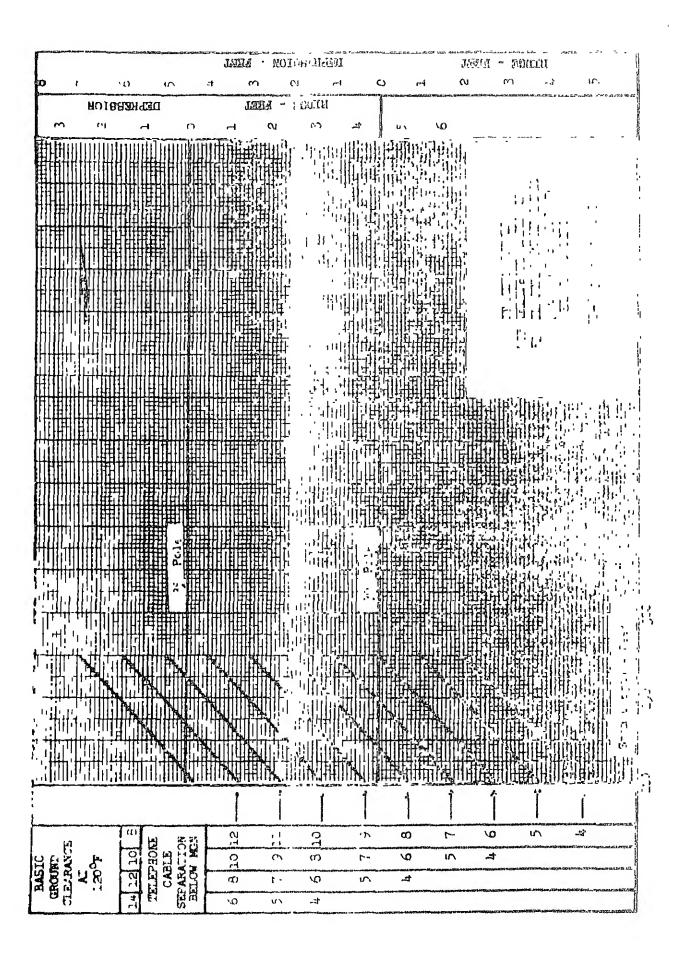
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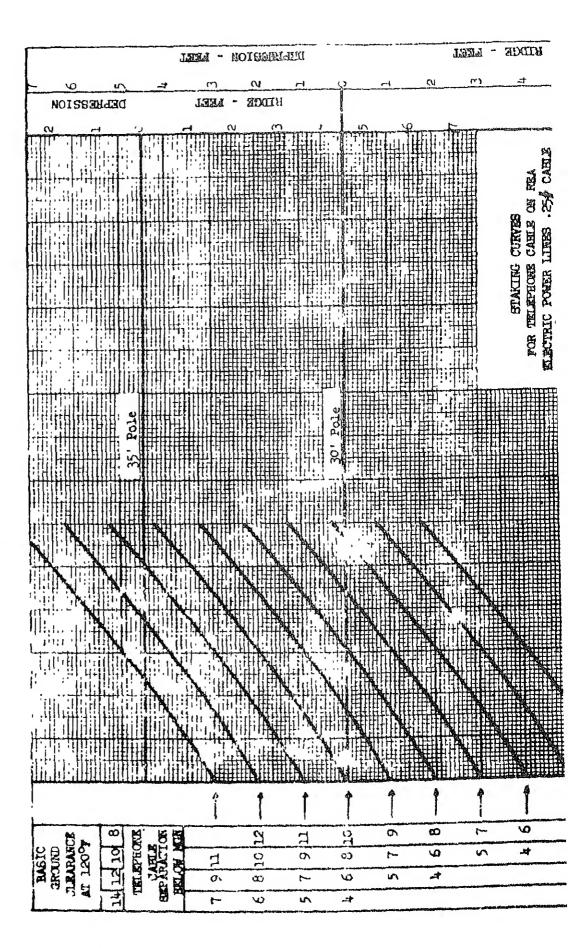
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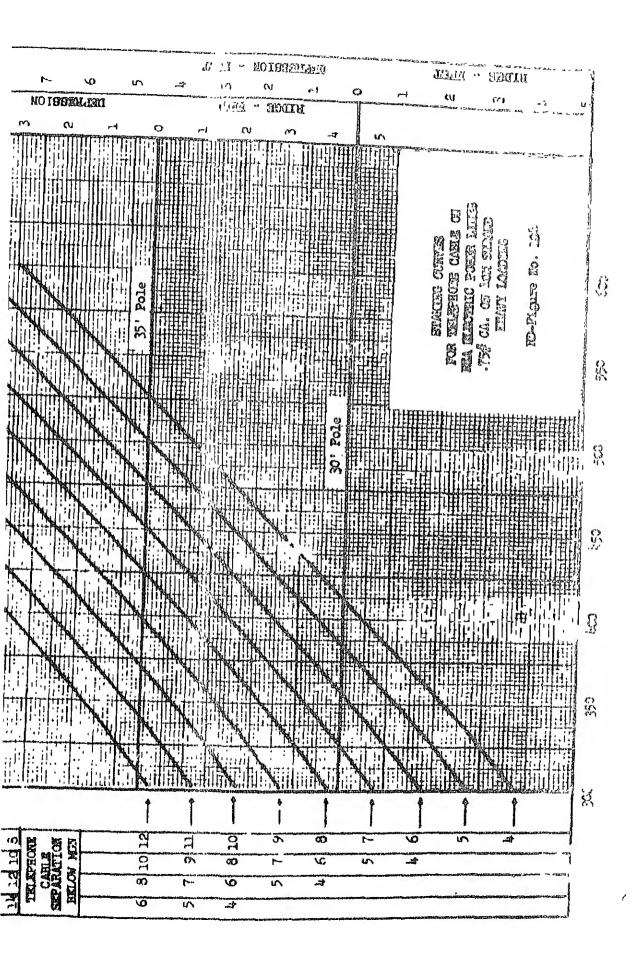
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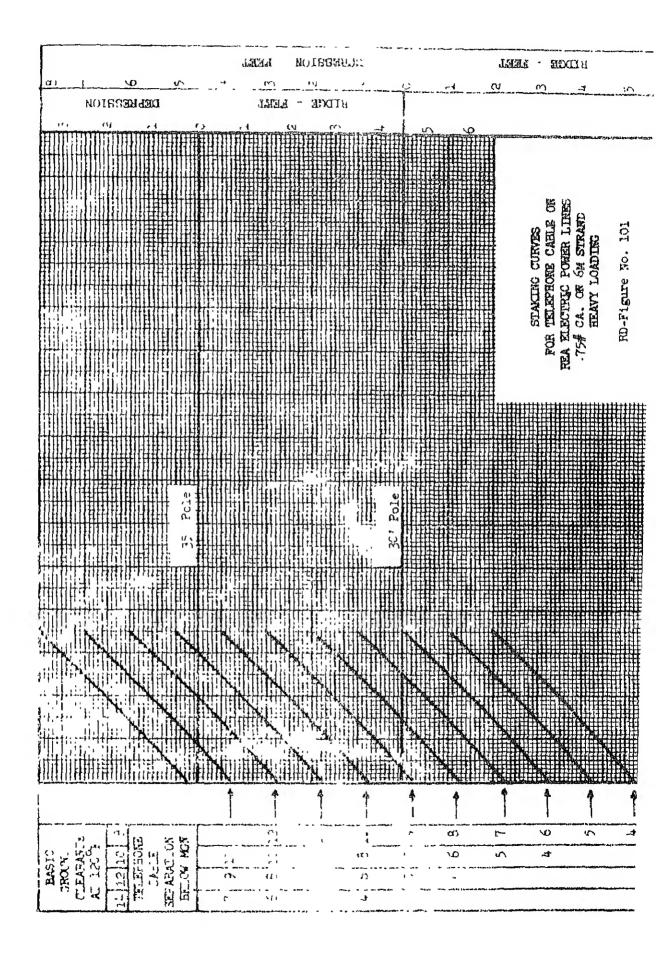
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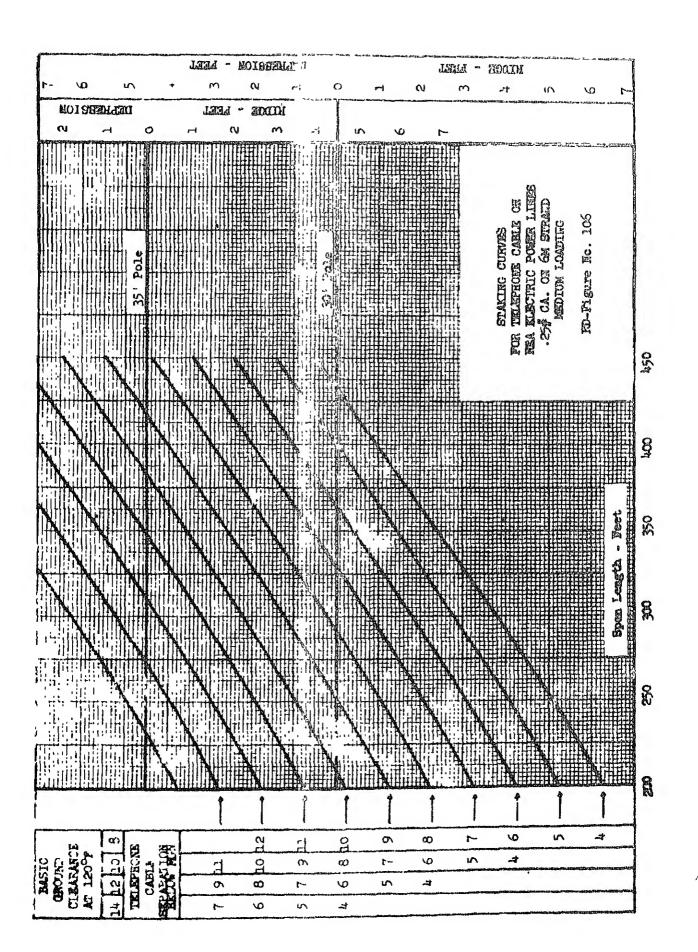
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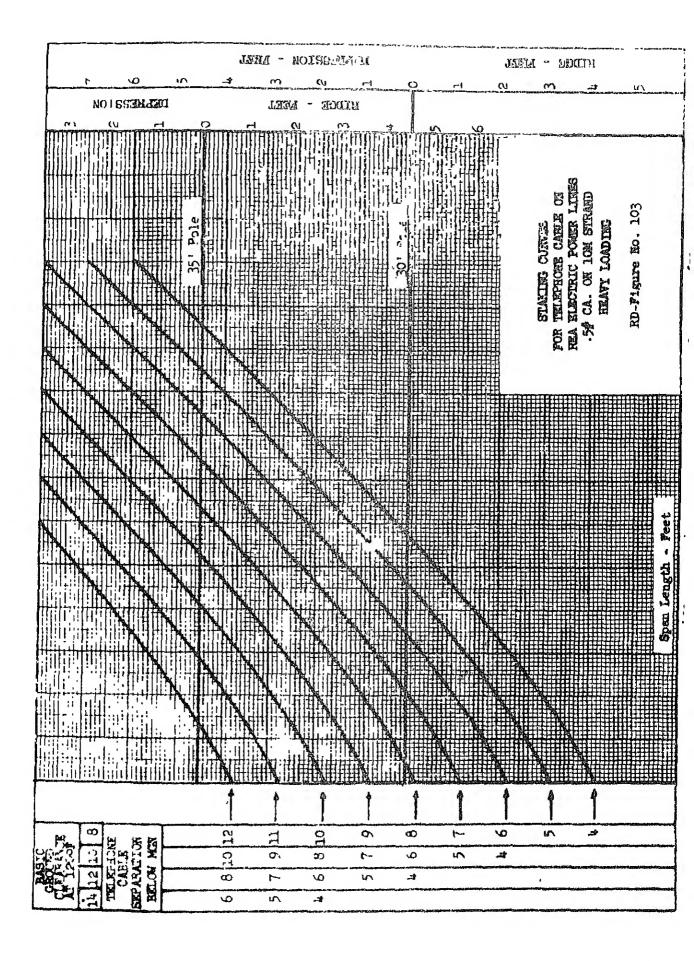


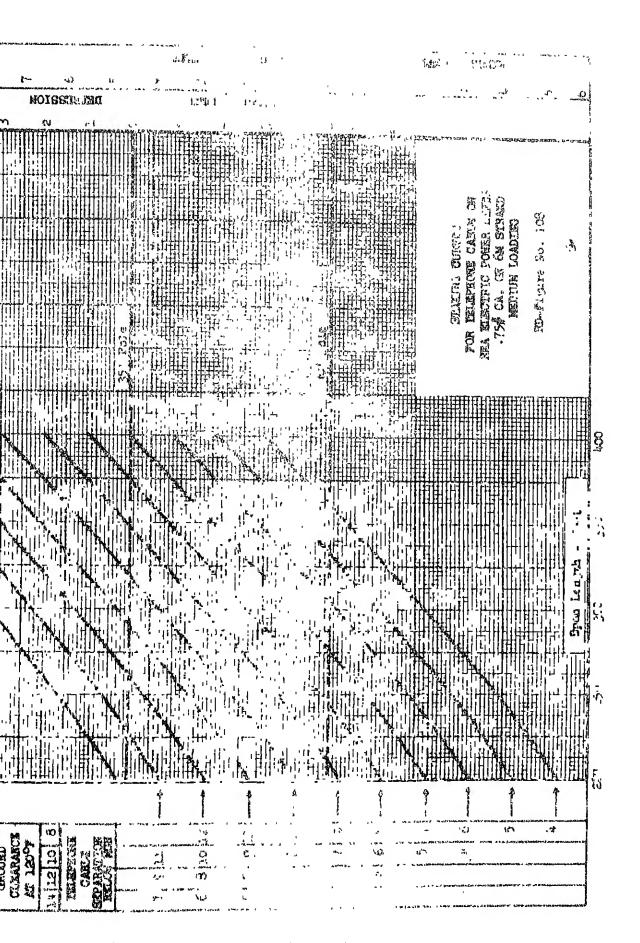




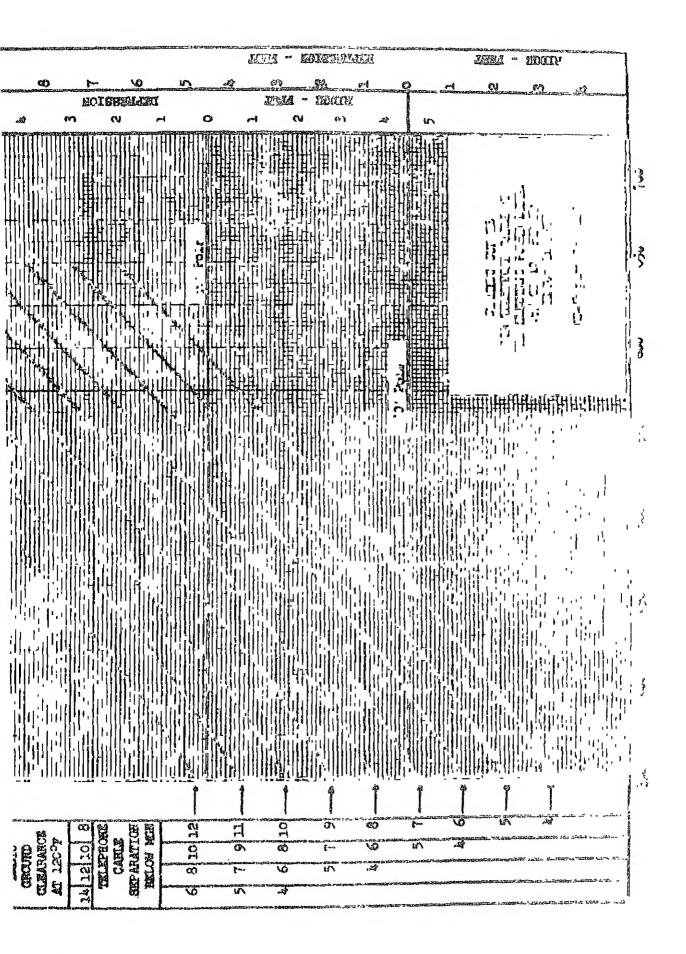


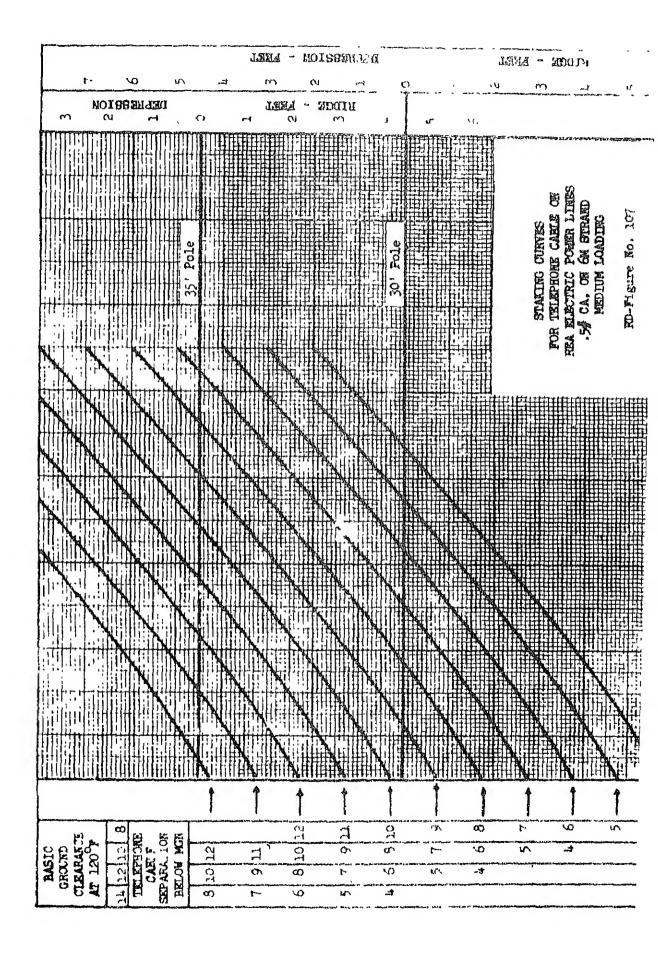


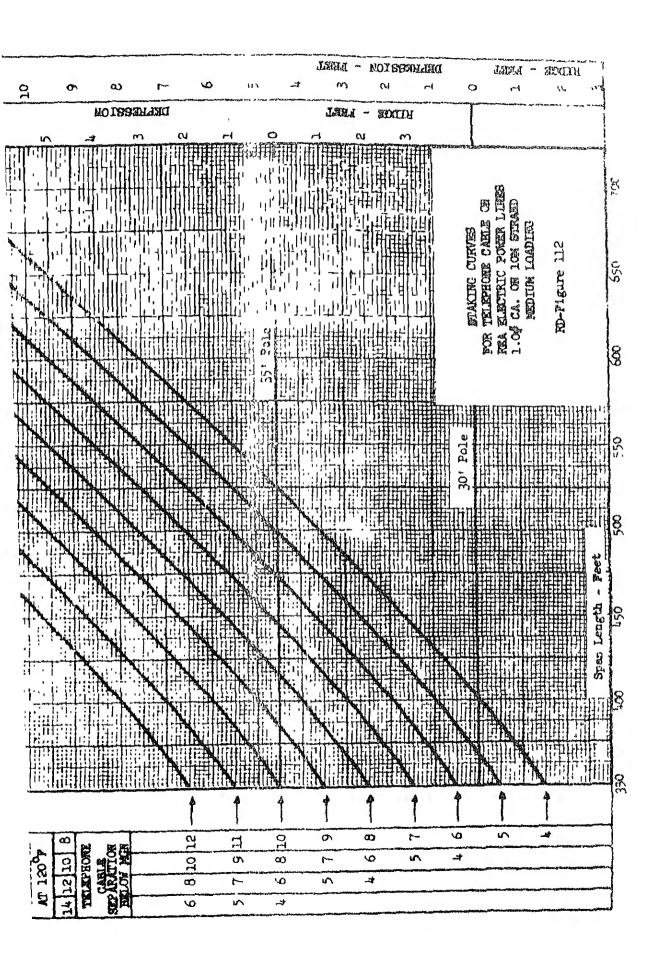


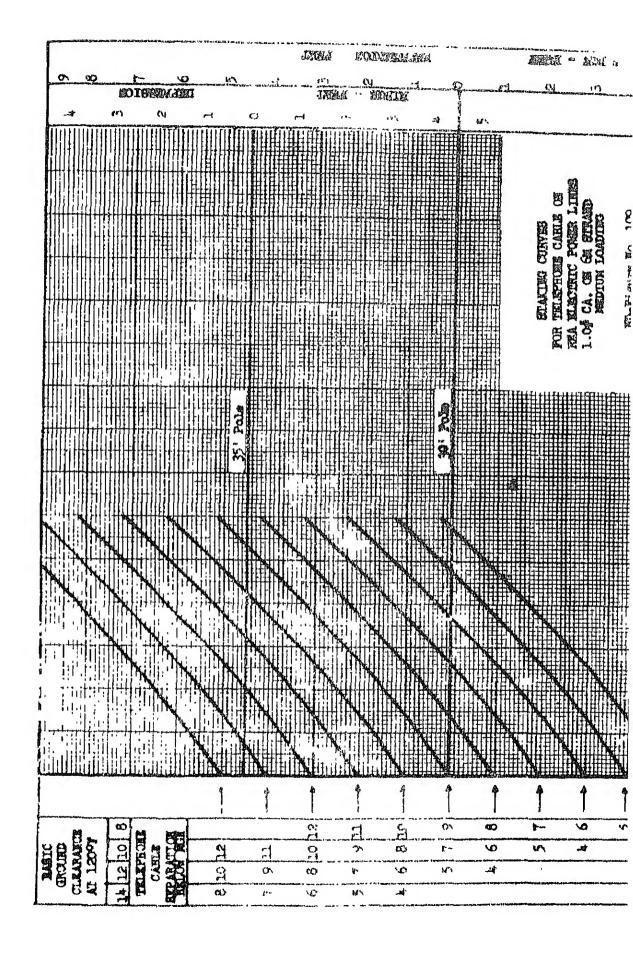


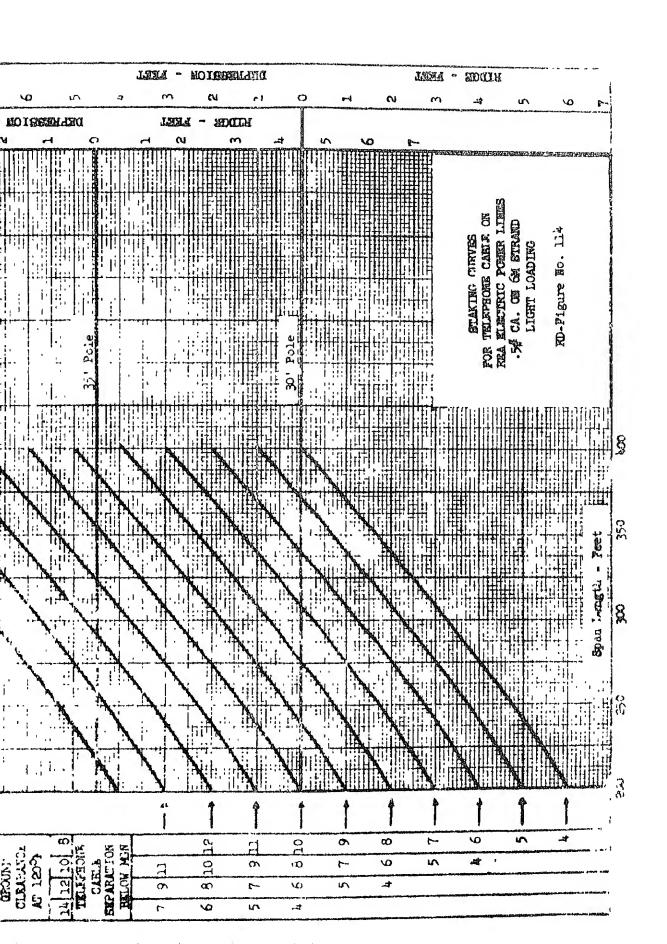
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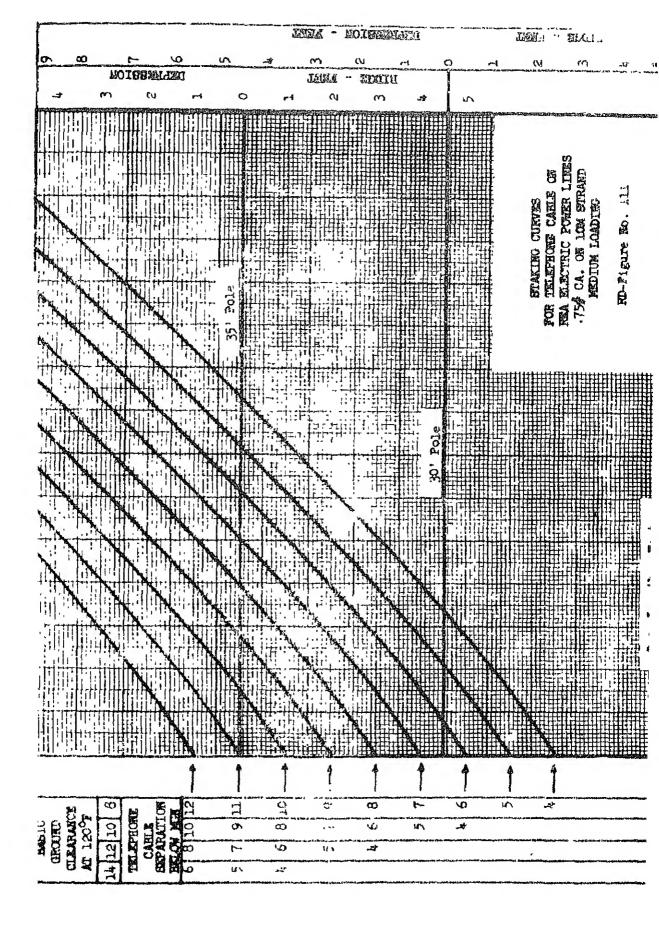












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